

## N O T I C E

THIS DOCUMENT HAS BEEN REPRODUCED FROM  
MICROFICHE. ALTHOUGH IT IS RECOGNIZED THAT  
CERTAIN PORTIONS ARE ILLEGIBLE, IT IS BEING RELEASED  
IN THE INTEREST OF MAKING AVAILABLE AS MUCH  
INFORMATION AS POSSIBLE

DOE/NASA CONTRACTOR  
REPORT

DOE/NASA CR-161679

SOLAR HEATING AND COOLING SYSTEM INSTALLED AT  
RKL CONTROLS COMPANY, LUMBERTON, NEW JERSEY --  
FINAL REPORT

Prepared by

RKL Controls Company  
P. O. Box 276  
Lumberton, NJ 08048

Under Contract EX-76-C-01-2397

Monitored by

National Aeronautics and Space Administration  
George C. Marshall Space Flight Center, Alabama 35814

For the U. S. Department of Energy



(NASA-CR-161679) SOLAR HEATING AND COOLING  
SYSTEM INSTALLED AT RKL CONTROLS COMPANY,  
LUMBERTON, NEW JERSEY Final Report (RKL  
Controls Co.) 258 p HC A12/MP A01 CSCL 10A

N81-23597

Unclas

G3/44 42087

**U.S. Department of Energy**



**Solar Energy**



## TABLE OF CONTENTS

(FINAL REPORT)

|   |          |
|---|----------|
| INTRODUCTION.....   | PAGE 1   |
| DESIGN PHILOSOPHY.....  | PAGE 3   |
| DESCRIPTION OF SOLAR ENERGY<br>SYSTEM & BUILDING.....                     | PAGE 5   |
| ACCEPTANCE TEST.....  | PAGE 19  |
| PREDICTED SYSTEM PERFORMANCE.....   | PAGE 20  |
| MAJOR PROBLEMS & THEIR SOLUTIONS.....                                     | PAGE 21  |
| LESSONS LEARNED & RECOMMENDATIONS.....                                    | PAGE 23  |
| STATEMENTS VERIFYING THE SOLAR SYSTEM.....                                | PAGE 26  |
| PICTURE INDEX.....  | PAGE 27  |
| SCHEMATIC PIPING DIAGRAM.....   | PAGE 36  |
| TYPICAL TEMPERATURE PRINTOUT.....   | PAGE 37  |
| PROCEDURES FOR MANUALLY OPERATING<br>THE RKL SOLAR SYSTEM.....            | PAGE 39  |
| MAINTENANCE BULLETIN FOR RKL DESIGNED<br>SOLAR COLLECTING SUB-ARRAYS..... | PAGE 48  |
| TYPICAL OPERATION MODES.....  | PAGE 50  |
| LIST OF AS BUILT DRAWINGS.....  | PAGE 60  |
| LITERATURE OF EQUIPMENT USED IN<br>THE RKL SOLAR PROJECT.....             | PAGE 99  |
| Solar Collectors.....   | PAGE 99  |
| Solar Piping.....   | PAGE 110 |
| Absorption Chiller.....   | PAGE 122 |
| Heat Recovery.....  | PAGE 133 |

**PRECEDING PAGE BLANK NOT FILMED**

TABLE OF CONTENTS (Continued)

(FINAL REPORT)

|                                |          |
|--------------------------------|----------|
| Solar Control Valves.....      | PAGE 139 |
| Pumps.....                     | PAGE 182 |
| Auxillary Electric Boiler..... | PAGE 189 |
| Cooling Tower.....             | PAGE 195 |

## RKL CONTROLS

## SOLAR SYSTEM

## FINAL REPORT

### INTRODUCTION:

The RKL solar project is located at the corner of Ark and Stacy-Haines Roads in Lumberton, New Jersey, at 39.8° latitude. It is approximately twenty miles due east of Philadelphia, Pennsylvania, centrally located in the highly industrialized corridor between Washington, D.C. and Boston, MA. At the time a cost-share contract was signed with ERDA, RKL Controls, Inc. was a privately held manufacturing corporation which owned land at the above mentioned site and had designed a building to be solar heated and solar air-conditioned for construction at this site. This building was to be designed specifically for solar heating and solar air-conditioning incorporating many novel design features. Before the system was completely finished, RKL Controls, Inc. was purchased by Robbins & Myers, Inc of Dayton, Ohio, with the transfer of ownership taking place in December of 1979. Final acceptance of the solar system occurred on November 1, 1980.

It should be noted that RKL Controls, Inc. were the designers, contractors, and owners of the facility.

The solar system became operational in October of 1979, on a manual, day-to-day basis for heating only.

During the summer of 1980, it became operational on a manual, day-to-day basis for air-conditioning only. Finally, in October, 1980 it became operational for heating and air-conditioning and was fully computer controlled.

## DESIGN PHILOSOPHY

It was the object, originally, to design an extremely energy sensitive building with a solar system incorporating the proven flat-plate collector to accomplish fifty percent (50%) of the heating load and forty percent (40%) of the air-conditioning load. It was also desired to design the unit with undersized collecting surfaces and oversized storage ability. It was also further desired to incorporate the latest technologies of micro-processors to completely control the system, collect data, analyze the data, and based on the analysis, pick the best modes of operation for a particular existing weather condition, all of this being done on a real time basis.

It was desired that the building and the solar collecting system be separate and that the collection system be located a ground level. It was to be as well protected as possible from the elements, be easily maintainable, with the possibility of vandalism kept as low as possible.

We also desired to make the solar system as flexible as possible with redundancy included in mechanical equipment wherever possible, thereby eliminating the possibility of shutting down the system due to a single equipment failure. The flexibility we were concerned with was in our piping and valving

so that switching could be made to multiple storage tanks either charging or discharging the tanks in parallel or in series.

It was further desired that the heat exchanger between the collecting loop and the storage and distribution loops be designed to operate at a minimum differential of two degrees Fahrenheit (2°F.) and that the air handling units within the plant also operate on a two degree Fahrenheit (2°F.) differential between plant air temperature and hydronic temperature.

In the design of this plant, which encompasses a typical machine shop, assembly, and test operation for the manufacture of control valves, we desired to include all types of energy saving devices and equipment. This ranged from high efficient electric motors to overhead barbershop type fans, and sodium vapor lighting throughout. As this was also one of the largest cost-sharing contracts under PON #1 and one of the few manufacturing facilities that was completely heated and cooled by solar, we set aside a section of the plant to become our computer and control center, designed in such a way that visitors could observe the operation of the solar system without interrupting normal manufacturing operations.

## DESCRIPTION OF SOLAR ENERGY SYSTEM AND BUILDING

The building, housing our manufacturing, sales and solar computer control center/display room, consists of 40,000 square feet of floor space and is of the conventional steel post in wall construction with a flat roof having a pitch from West to East of one foot (1') per hundred feet.

The offices are located on the South wall of this building with the solar computer control center/display room and the mechanical room in the Southeast corner.

The entrance to the offices of RKL Controls is nearest the parking lot and the West end of the South wall for convenience of employees, with a separate entrance into the display room at the East end of the South wall.

The only windows are on the South wall and consist of six foot (6') high, six inch (6") wide slit windows, double glazed for low energy loss, narrowness to prevent breaking and entering.

The walls between the offices and the manufacturing area are insulated both to prevent noise penetration and loss of energy, as the manufacturing area is generally kept cooler in the winter and warmer in the summer than the offices.

All entrances to the building, either man-doors or loading doors, were surrounded by air locks with double doors, including overhead doors.

The overhead doors were especially designed, fully internally foamed metal construction, one and a half inches (1½") thick with seals on all four edges and between panels. They are interlocked in such a way that no door from the outside can be opened at the same time as an inside door.

All man doors open outwardly with emergency panic bar control for easy exit from the building in case of emergency. Entrances from shipping and receiving are on the East wall of the building, as prevailing winds are from the Southwest, with large machinery loading and unloading doors on the West side, which are only opened occasionally. The North wall has no openings into the building.

The building itself is insulated on the outside with a two hundred and fifty pound (250 LB.) density sprayed urethane foam on the vertical walls (1-1½" thick) and a three hundred and fifty pound (350 LB.) sprayed urethane foam on the roof (2½-3" thick). RKL Controls Construction Division bought the equipment and sprayed the external surfaces so that there was a homogeneous insulated cover on the surface of the building. The urethane surface was spray painted with a special UV resistant, white acrylic paint, such coating being approximately 50 mils thick, consisting of two (2) coats on the vertical surfaces, each coat being sprayed in two directions, and one heavy coat on the horizontal surfaces, being sprayed in two directions.



All fresh air vents, sky lights, and smoke vents were installed before the spraying operation so that no separate sealing would be necessary.

The foam was sprayed directly onto the cement block and directly onto the W-form steel roof deck so that extremely tight adhesion would occur.

This insulation has proved extremely satisfactory in making the building very air tight. Spraying the foam on the outside of the building eliminates any toxic gas effect within the building if there should be a fire, and allows the mass of the building to become a large heat sink thus increasing our storage capacity.

By spraying the foam in place onto the steel deck and cement block walls instead of a layup of urethane sheeting, we were able to eliminate all seaming seals on the surfaces. Spraying saved a tremendous amount of labor and consequently reduced the cost of insulation.

The sprayed urethane is pliable and expands and contracts with the building without cracking.

Within the building we located four large air handling units with extremely large built-in copper fin-tube heat exchanges. These air-handling units are located in the manufacturing area with dual speed fan motors and are so constructed that there are four sets of four coils in each air handling unit. This allows us to preheat with low quality solar heated water and do final heat with high quality solar or electrically heated hot water to gain the maximum use of the solar energy storage. Each air-handling unit has eight automatic valves, manufactured by RKL

Controls, which allows any one of all four coils to be used in any combination of preheat and final heat. One of the large air handling units has a heat pipe system build into it that preheats fresh air brought into the building, from the outside, on a 24 hour basis. Pre-heating occurs by removing the heat from the exhaust air and transferring it to the incoming air, via a heat pipe system which is approximately sixty percent (60%) efficient. Also each one of these air-handling units has automatic louvers which allow us, during cool, dry nights in the summertime to bring in cool, dry air, thus reducing our air-conditioning requirements during our heaviest load periods. These fans are sized to completely change the air within the plant within ten minutes. All of the air passing through these air-handling units is filtered. The discharge is downwards throughout a 360° pattern. The air-handling units in conjunction with twelve (12) overhead, barbershop type fans located two (2) feet under the ceiling between bar joints, allows us to maintain a two degree Farenheit (2°F.) differential between the floor and the eighteen (18') to twenty (20') foot ceiling. Two smaller dual speed air handling units circulate filtered air from the plant through the offices and back out into the plant. All of the air-handling units are fully controlled by the computer and any one or all can be turned on at any given time, depending upon the conditions in the area that a particular air-handling unit services. All of the control between the computer and these air-handling units is accomplished

through optically isolated relays.

Room air temperature sensing occurs at one location and three different levels within the offices, ceiling, six feet above the floor, and three feet above the floor. Air temperature sensing occurs at three different levels and four different locations within the plant.

Relative humidity is sensed within the offices, within the plant, and outside the building, as is outside air temperature, wind direction, and wind speed.

Each of the shipping and receiving air locks as well as the mechanical room itself has vent fans blowing out of the building in the cooling season and into the manufacturing area during the heating season. The main shipping/receiving air lock has the air compressors located within it and these air compressors generate heat which is used to help heat the plant manufacturing area. The mechanical room also becomes quite warm during solar collection periods and this heat is circulated into the plant to help with our heating load. During the summer months the mechanical room becomes quite warm and fresh air is circulated throughout the room to the outside to help reduce the cooling load of the building. The same is true with the air in the air locks during summertime. Temperatures within these areas are sensed, and the computer makes the decision whether to circulate air from the various air locks and mechanical room into the plant or to the outside,

All partitions between the mechanical room and the manufacturing area are insulated with vermiculite inside of the cement block walls to prevent heat loss or gain into these areas.

Four sky-lights in the manufacturing area also serve as drop-in type smoke vents in case of fire. These sky-lights are double glazed plexiglass with a gold flash inside the outer plexiglass layer to reflect as much infared during daylight hours as is possible.

All internal and external man-doors into the air locks are one and half inches (1½") thick with fully urethaned foamed cores. Door lights are six inches wide by two feet high, double glazed.

The display room itself has a seventeen foot high ceiling with (3), four by six foot double glazed panels looking into the machanical room. This room contains our computers behind a partition with office area above and our L-shaped solar control console. There is space for approximately twenty people at one time to watch what is going on in the solar collecting area over closed circuit television, and observe what is going on in the mechanical room.

The mechanical room has all piping and control valves located eight feet above the floor or on the walls. All solar piping is made of glass reinforced high temperature modified epoxy and is used throughout the collection loop, the storage loops and the distribution loops.

The distribution loops to the air-handling units within the manufacturing area are of the fully balanced continuous return type. There are two parallel distribution loops, one for low quality energy from one source for pre-heating, and the other for high quality energy from another source which could either be storage or our auxillary hot water heater, for final heating purposes. The same is true for cooling purposes. In other words, low quality energy for pre-cooling and high quality energy for final cooling.

All valves within the system except handwheel operated isolation valves are pneumatically operated with all control solenoids located in one panel, optically isolated from the computer. Pneumatic relays on each control valve are operated by these solenoid valves. There are seventy-five (75) temperature sensors located in various sections of the piping system for use in computer analysis of the data collected. We chose to use thermisters in all cases for ease of multiplexing.

The advantages of the above mentioned high temperature plastic piping are quite obviously, the weight of the piping, the ease of the fabrication, as all fittings are epoxied in place, and cost, which was a great deal lower than copper piping. This plastic piping has an operating temperature of 225°F. at 100 PSIG, well above our maximum operating temperature of 210°F. and maximum working pressure of 50 PSIG.

All piping is connected to each piece of mechanical equipment with elastomeric expansion joints manufactured by RKL Controls. Expansion joints are also located in long runs of this pipe at specified intervals.

There are one hundred and eighty (180) control valves in the system, all of the RKL Controls' type SG, or SGE, which offer absolutely drop tight closure, corrosion resistance, and extremely low pressure drop. These valves are used, not only in the mechanical room, but throughout the distribution system and on the air-handling units.

The storage loop piping is so designed that we can either store in series or in parallel, to any one or all five storage tanks. At the same time we can remove from any or all tanks in series or in parallel depending upon conditions we want to achieve. This facility, as we mentioned before, was designed not only as a practical heating and cooling demonstration, but also as a research facility, thus the reason for our high degree of flexibility.

The auxiliary hot water heater is located in the mechanical room as are the two (2) twenty-five ton (25) ARKLA chillers and the eight (8) Ingersoll-Rand outboard bearing pumps.

Also located in the mechanical room are the water treatment systems for our potable water and our cooling tower water. The latter is used only during the air-conditioning season.

The solar storage system consists of six (6) tanks, four (4) of which are ten thousand (10,000) gallons, and two (2) of which are five thousand (5,000) gallons. These tanks are located just outside the East wall of the mechanical room, above ground.

They are of stainless steel construction, 20' tall, standing vertically, and are insulated with 6" of sprayed urethane insulation, painted white. There are four (4) six inch (6") diameter pipes connected to the storage loop inside of the mechanical room, two at the bottom and two at the top with internal vortex eliminators. Each tank has a stainless steel hinged man-sized inspection port at the top, and are vented to atmosphere. Also each tank has a temperature probe located at the bottom, the middle, and the top with an extension pipe that goes to the center of the tank. All tanks are connected to the plastic piping entering the building with elastomeric flexible connectors manufactured by RKL Controls and each pipe is insulated with two inches (2") of cast urethane foam, covered with an ultra-violet resistant polyvinylchloride white, glued in place plastic sheeting, as is all of the piping external to the building.

The solar collection loop leaves the Southeast corner of the building, crosses a bridge to a bermed area, down inside the berm, forming a fully balanced loop within the berm, where the solar collectors are located. The bridge is of the single suspension type,

suspended from the building with stainless steel wires and is constructed of standard beam forms of pultrusion type epoxy plastic reinforced with glass, as are all pipe supporting bridges in the berm area. These bridges require no maintenance, such as painting.

The berm itself is constructed of earth from the site and is so designed that when the arrays are horizontal they are below the edge of the berm and out of sight. The berm acts as a wind shield preventing damage to the arrays during high wind conditions, such as the occasional hurricane force winds that come across Southern New Jersey every two or three years.

The solar collecting arrays consist of twelve sub-arrays located in two rows of six each. Each sub-array is individually controlled so that it can be tilted on an East-West axis from an upside down condition to the correct angle for optimum collection on a given day or given hour of that day. Each sub-array consists of twenty-seven Sunworks flat-plate collectors, double-glazed with selective surface copper sheet and tube.

There are three rows of nine solar collectors on each sub-array and each row is connected to the one above so that there is a cascading effect for high quality energy collecting. There is a centrally located starter relay control panel in the berm, with manual override for each sub-array which is driven at one RPM by a one horse power double reduction gear motor through a heavy link chain drive.



There are two headers, one at the inlet and one at the outlet, bottom and top respectively, which run to either side of the sub-array. These inlet and outlet headers are connected to a 2" ID looped wire-reinforced high temperature hose which is in turn connected to its respective inlet or outlet loop at the base of the arrays.

Each sub-array is isolatable with RKL pinch type handwheel operated shut-off valves and each sub-array has a relief valve located at the highest point. The individual collectors are connected to each other and the headers with high temperature EPDM flexible hose to take up for expansion and contraction.

Sub-array structures are constructed of structural steel members and a tubular steel shaft with self aligning bearings at either end. There is a common A-frame support between each sub-array and an individual A-frame support at either end anchored to large 12" thick concrete pads at each leg. Each leg is held to the pad by three (3) adjustable clamps with bolts buried in the pad for easy alignment or re-alignment if any pad should shift.

There is an Eppley Photometer located on its own collapsible support between the south row of six sub-arrays, exactly in the center of the line of six sub-arrays. It is easily lowered for inspection and cleaning.

Each sub-array has its own inclinometer which feeds back to the computer for exact positioning. There is also a high temperature probe on each sub-array, placed

against the collector absorption surface of the top central collector for monitoring temperatures and indicating any stagnation conditions.

At the end of the return collection loop within the berm, there is a three inch (3") relief valve which discharges into a holding tank so that any overpressuring due to stagnation or other reason will discharge the propylene glycol, used during the winter months, into the holding tanks, thus preventing a spill. The flat surface inside the berm under the array area is covered with a light road-bearing bituminous concrete, black in color, for easy access to each sub-array for repair and maintenance and to absorb heat during the summer months, which radiates up towards the upside down collectors after darkness so that residual heat decay will be reduced during our heavy load cooling season.

The entrance to the berm is located on the East side away from the direction of prevailing winds. The berm also serves to reduce edge losses during the winter season when winds average five to ten (5 to 10) miles per hour.

Each sub-array is spray foamed with urethane on the back side so that moisture and ice will not collect on the backside of the arrays between its structural beams, when they are upside down during dark conditions or stormy weather. This also reduces back side heat loss, of individual collectors, to practically zero (0).

The complete solar loop holds approximately two thousand gallons (2,000) of a fifty percent (50%) solution of propylene glycol and water during the winter months.

This propylene glycol and water is drained into the two thousand (2,000) gallon holding tank, located in the berm, from the solar collection loop during the summer months and replaced with water. This prolongs the life of the propylene glycol. We also gain the advantage of using water, during our highest load cooling season, which has a better specific heat than the propylene glycol/water mixture.

Because the arrays are rotatable to an upside down position during windy or bad weather conditions and at night, the maintenance involved in keeping the double-glazed surface clean is reduced drastically. Also we do not have to wait for any snow or ice to melt from the collecting surface of the flat-plate collectors during winter weather as no ice or snow collects on the double-glazed glass surface.

Each row of six (6) sub-arrays are spaced in the berm area so that mirrors can be added, if desirable, at a later date without being shaded by the berm or the Southern row of sub-arrays. The complete area is fenced with a ten foot high (10') chain-link fence to prevent vandalism or damage to the area by inquisitive people.

Just East of the storage tanks, on a separate pad is located the cooling tower which is only used during the cooling season. It is a conventional open cooling tower circulating air through it from West to East, which is the prevailing wind direction.

The berm, 40,000 square foot manufacturing facility, and parking lot occupy approximately five (5) acres in the Southwest corner of a presently-owned thirty acre piece of land with its own fire protection pond, at the corner of Ark Road on the West and Stacy-Haines Road on the South, in the town of Lumberton, New Jersey. All drainage from the property and from the berm area enters the holding/fire-protection pond.

Television surveillance cameras are mounted in the parking area and on the top of the berm at the Southeast corner to give us surveillance of the solar array area from the computer room. We also record from these cameras, by stop motion recorder, for a period of three days (3) before the tape is erased and re-recorded.

The parking lot is lighted by high-pressure sodium vapor street lights for low energy usage, as are all external lights in the berm area and on the building itself.

## ACCEPTANCE TEST

As the system became operational beginning in the Fall of 1979, using only manual operation, it was decided to put off the formal test plan until the computer programs were finished and de-bugged to the point where they could completely operate the system in both the heating and air-conditioning modes without manual assistance. The cooling mode programs were completed in the Summer of 1980, and were run for quite some time before the heating season occurred. In early October of 1980, the heating programs were run and de-bugged. Finally, on October 29, 1980, Mr. Jim Hankins of NASA arrived to observe both programs running and to check on the efficiency of the solar collecting loop. Both the heating and the cooling programs ran satisfactorily and it was determined by Mr. Hankins that the solar collecting loop had run at about thirty-five percent (35%) efficiency, which was in the area that we expected.

It now remains for us to collect data over an extended length of time, analyze the data, determine whether any changes to the computer programs would be advantageous, and if so, make these changes. However as the system now stands RKL Controls has accepted the design, the construction, and the operation of the system.

As we do have the capability of choosing from some sixty-four (64) possible modes or combination of modes, we plan to experiment with the system over the next few years to see if we can increase the efficiency to a level where we can completely separate ourselves from any auxiliary source of heating and cooling.

### PREDICTED SYSTEM PERFORMANCE

It is our firm belief that this system at RKL Controls can accomplish 100% heating and cooling in a hands-off operation with relatively low maintenance.

This can, however, only be accomplished if the necessary effort is expended.

First, it is required that the computer be reprogrammed to increase efficiency.

Second, it is absolutely essential that management and employees be educated towards developing attitudes which would lead to the understanding of the necessity for further research on this project. Energy conservation is one of the most important issues facing this nation, not so much for this moment, but for the future. The vision to see that point is of utmost importance.

## MAJOR PROBLEMS AND THEIR RESOLUTIONS

As this system has been operational in various modes manually for the past year and a half, we have discovered most of the major problems. Corrective action was taken at the time the problems arose. At the time of official acceptance most of these problems had been eliminated.

Some of these problems are listed below:

Leakage of hose connection between the flat-plate collectors due to faulty installation of the hose connectors. As leaks have occurred the short length of hose between the connectors has been lengthened and more care has been taken in applying the hose clamps.

Leakage of the hose loops between the solar collector loop and each individual sub-array. The original hose specified was of too light-weight construction and many pin holes were found in this wire-reinforced radiator type hose. We eliminated the problem by going to a heavier EPDM steam type wire-reinforced hose with swaged screw connections at both ends.

We have had some problems with limit switches on the sub-arrays which were primary for safety shut-off to prevent overtravel. These switches are being replaced with a better grade switch and being re-located to prevent this problem from occurring in the future. Also these limit switches will have a back-up limit switch for redundancy purposes.

The other major problem area has been with our microprocessors in the control room. They have failed due to electrical outages. We have now attached the microprocessors to the UPS's so that we can go through an orderly shut down of the microprocessors without creating problems when the main power into the building comes back on.

The rest of the problems are relatively minor; the failure of a solenoid operated control valve, dirty air, moisture in the air, and so forth. .



## LESSONS LEARNED AND RECOMMENDATIONS

The major lesson learned is that this project probably should have been limited to a bare bones heating and cooling facility, not as a research and development as well as an operational heating and cooling facility. If this had been done, a great deal of the instrumentation, the number of operating modes and so forth could have been eliminated, as well as a number of control valves and a large part of our piping. This would make the system much more cost effective.

We have also learned that the programming should have been done from the beginning by an outside consulting firm, as there would be much more depth in programmers to take care of any loss in programming personnel during the development stage of the project. This would have been less costly in the long run, both in time and money.

Some of the lessons learned that are on the positive side are that the urethane foam on the outside of the building gives a much tighter and consequently a much more energy efficient building than other types of construction. It is extremely satisfactory.

We have also learned that having the oversized storage, which is less expensive than collector arrays, has contributed greatly to the success of this project, as we are able to operate our heat distribution system from storage for periods of up to five (5) days when we can not collect solar energy. We have also learned that having multiple tank storage makes it easier for us to obtain high quality energy faster during short periods of high intensity sunlight.

The fact that we can rotate our collectors, turning them upside-down during bad weather, makes them more efficient in the winter time when snow and ice conditions are prevalent, as well as allowing us to increase efficiency during clear weather by tracking in a North South plain on an hourly basis.

We have further learned that the double glazing and cascading has allowed us to reach a higher quality level of energy, and that flat plate type collectors can be used to operate absorption type chillers without the necessity of going to a very expensive concentrating collectors.

Another plus has been the berm surrounding the solar collecting area. Comments have been very good from neighbors as to the aesthetic value of the berm and we do gain quite a bit by the reduction of edge losses of our collector surfaces as well as protection from hurricane force winds, which we have experienced twice in the last two years.

We have also learned that the overhead barber shop type fans have been very successful in distributing our heat from floor to ceiling level in a much more uniform way and that the sodium vapor lighting has decreased our electrical energy cost.

The air locks between all of the outside entrances and plant entrances are also valuable in keeping down energy losses from the building.

The location of the solar storage tanks above ground need not detract from the beauty of a site if properly located. They are much easier to maintain and there is less energy loss from our storage system during our heavy load cooling season when

we are able to store high temperature water for operation of the chillers at night time. There would be a much higher loss if these tanks were located underground

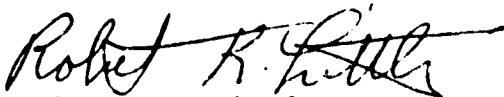
Of course the advantage of having the solar collectors at ground level is obvious. Maintenance problems are reduced drastically. There is also the cost consideration of mounting collectors on the roof of a building due to additional support members for the roof and the fact that an exposed array system on the roof of a building is subject to wind damage, and people walking below could be hurt by falling glass or debris. All of these problems have been eliminated by having the array system at ground level.

## STATEMENTS VERIFYING THE SOLAR SYSTEM

The solar system was built as per design drawings which were changed during the course of the building operation. However, it must be kept in mind that RKL Controls was the designer, the contractor, and the owner of this building, so decisions to change these designs were relatively easy to make during the building and construction phase of the project. RKL Controls accepts its own designs and construction without hesitation and feels that the acceptance tests were more than satisfactory.

RKL Controls also feels that all the interim performance criteria requirements were met.

Respectively submitted,



Robert K. Little  
Solar Manager  
RKL Controls

RKL/k11

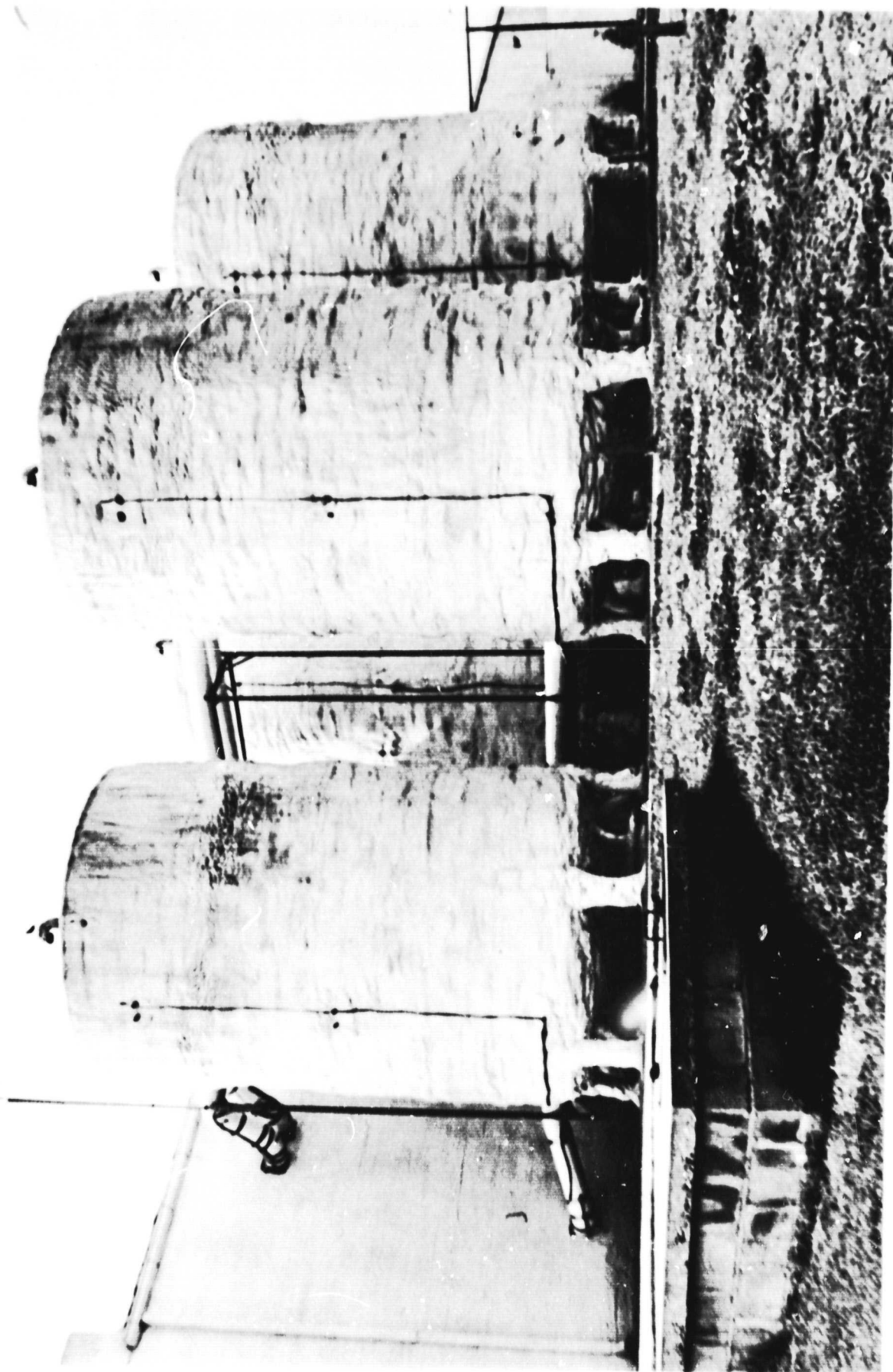
## PICTURE INDEX

| <u>DESCRIPTION</u>               | <u>PICTURE PLATE NUMBER</u> |
|----------------------------------|-----------------------------|
| Aerial View of RKL Controls      | 1                           |
| Storage Tanks                    | 2                           |
| Solar Arrays                     | 3                           |
| Computer Control Console         | 4                           |
| Plant Air Handling Unit          | 5                           |
| Mechanical Room - Pump Alley     | 6                           |
| Mechanical Room - Aux. Heater    | 7                           |
| Mechanical Room - Control Valves | 8                           |



RKL Controls Solar Heated/A.C. Mfg. Plant  
Looking N.W.  
Dec. 1980

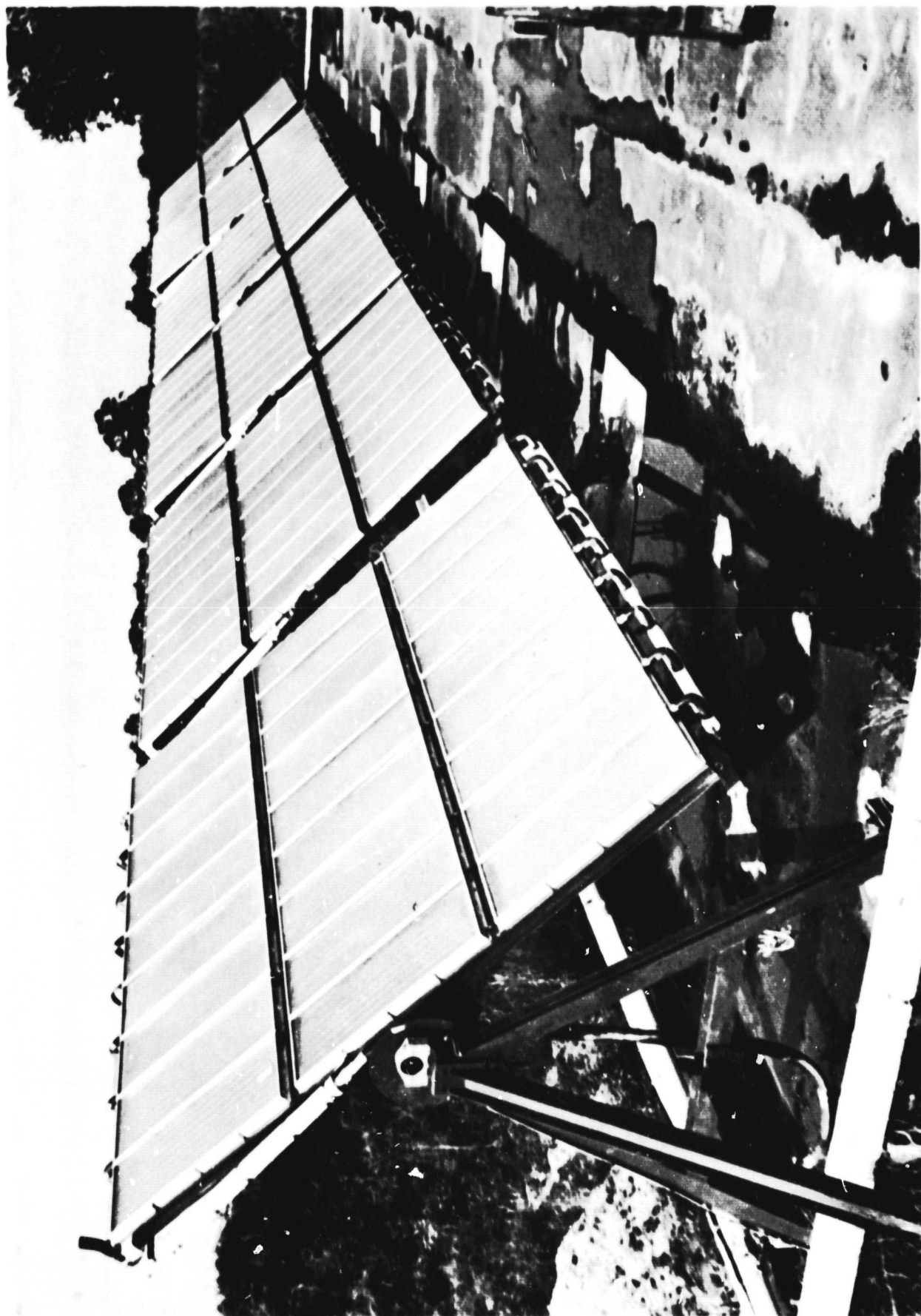
PICTURE PLATE #1



PICTURE PLATE #2

RKL Controls

Four of Six Storage Tanks  
covered with 6" of foamed  
Urethane Insulation.

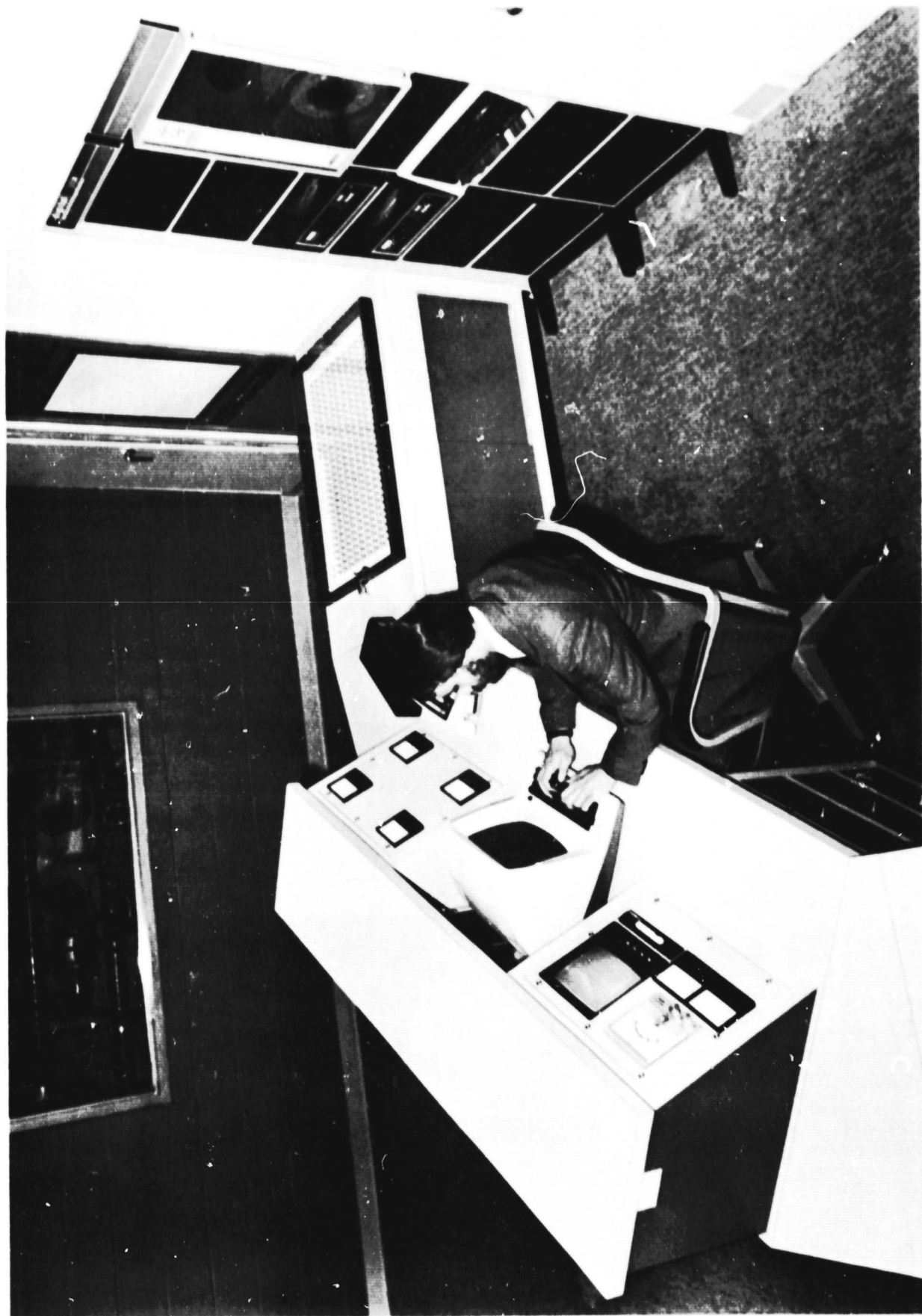


PICTURE PLATE #3

PKL Controls

One of two Solar Arrays  
each consisting of six  
Sub Arrays

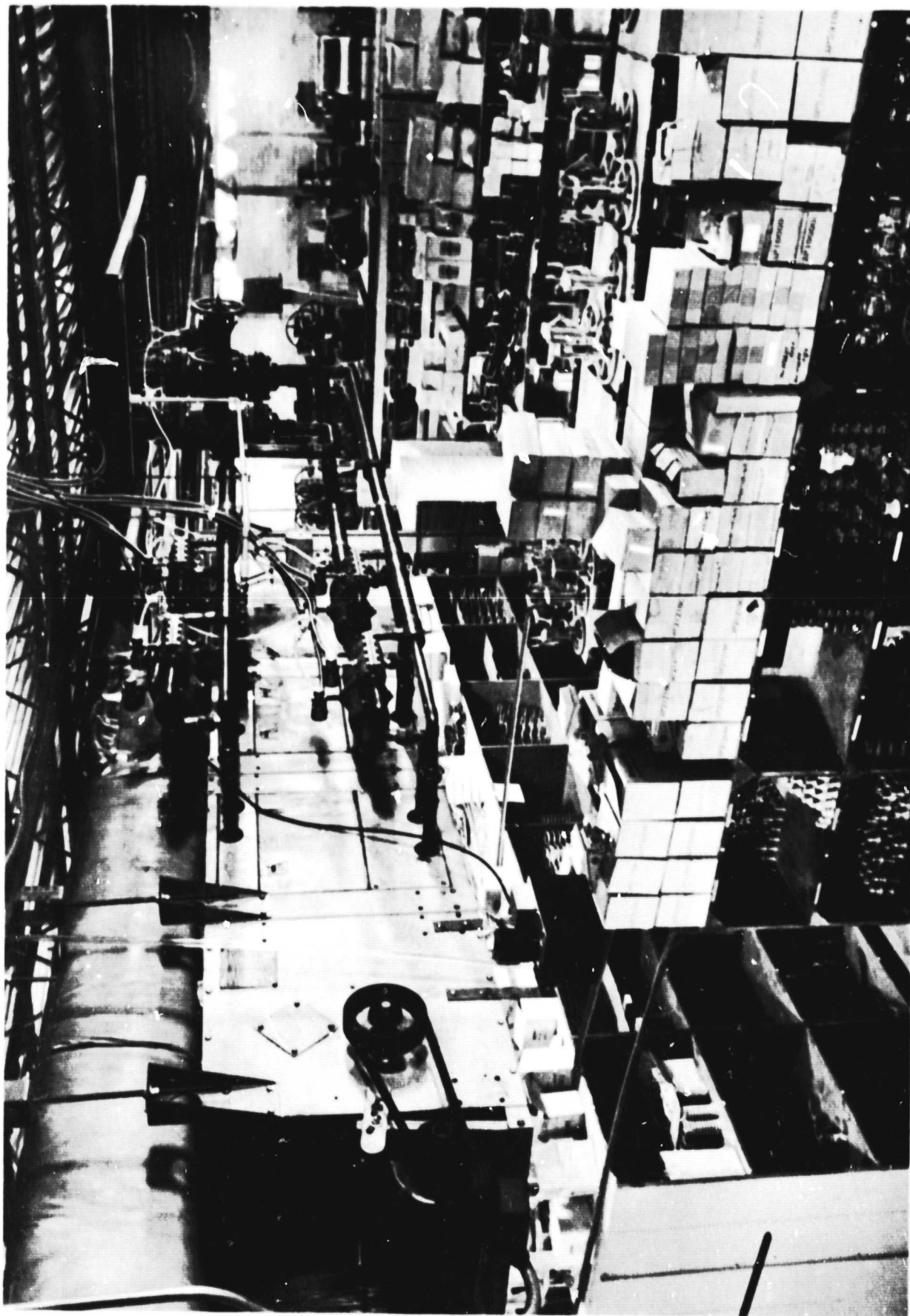




Solar Computer Console  
in Display Room

RKL Controls

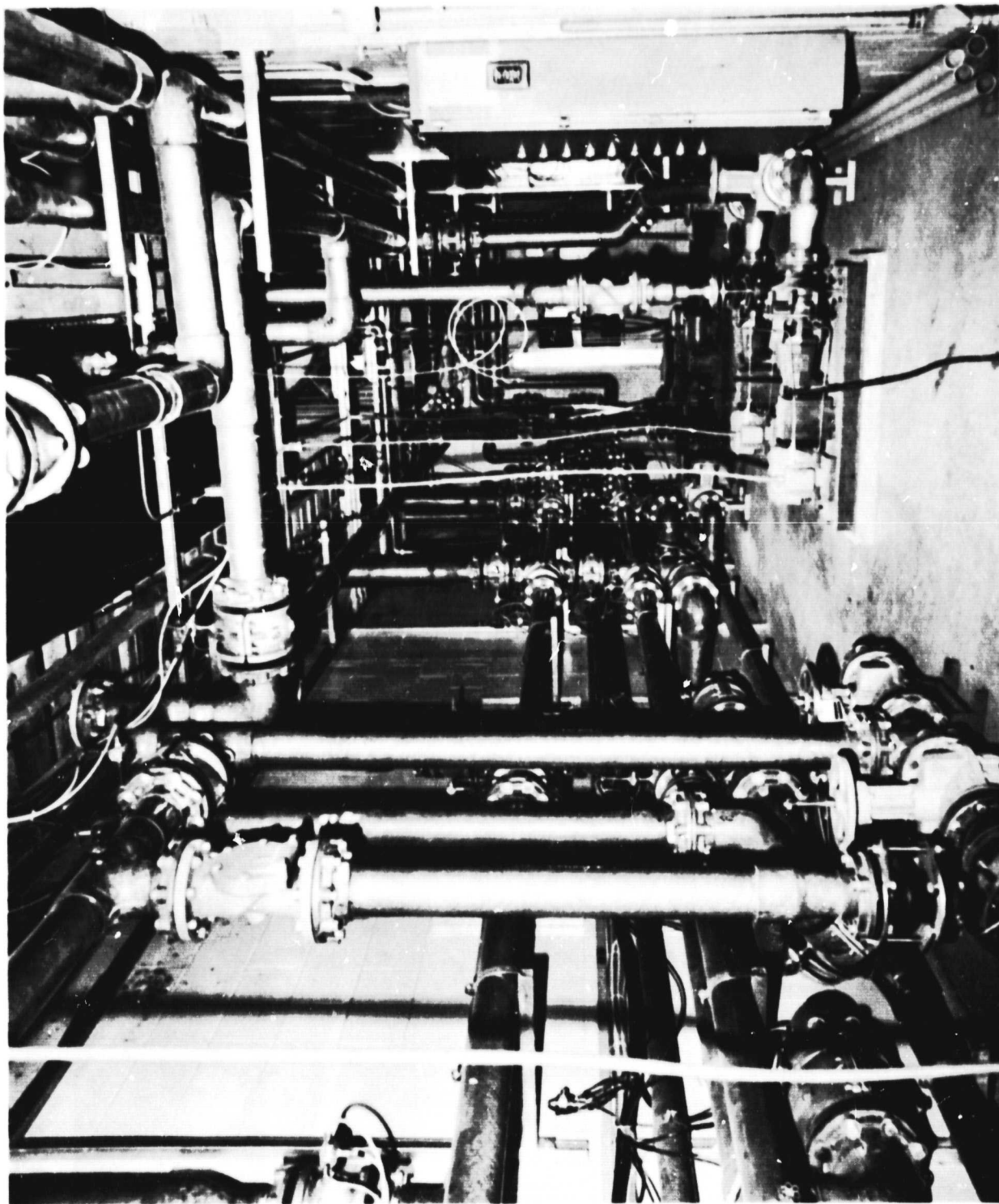
PICTURE PLATE #4



PICTURE PLATE #5

RKL Controls

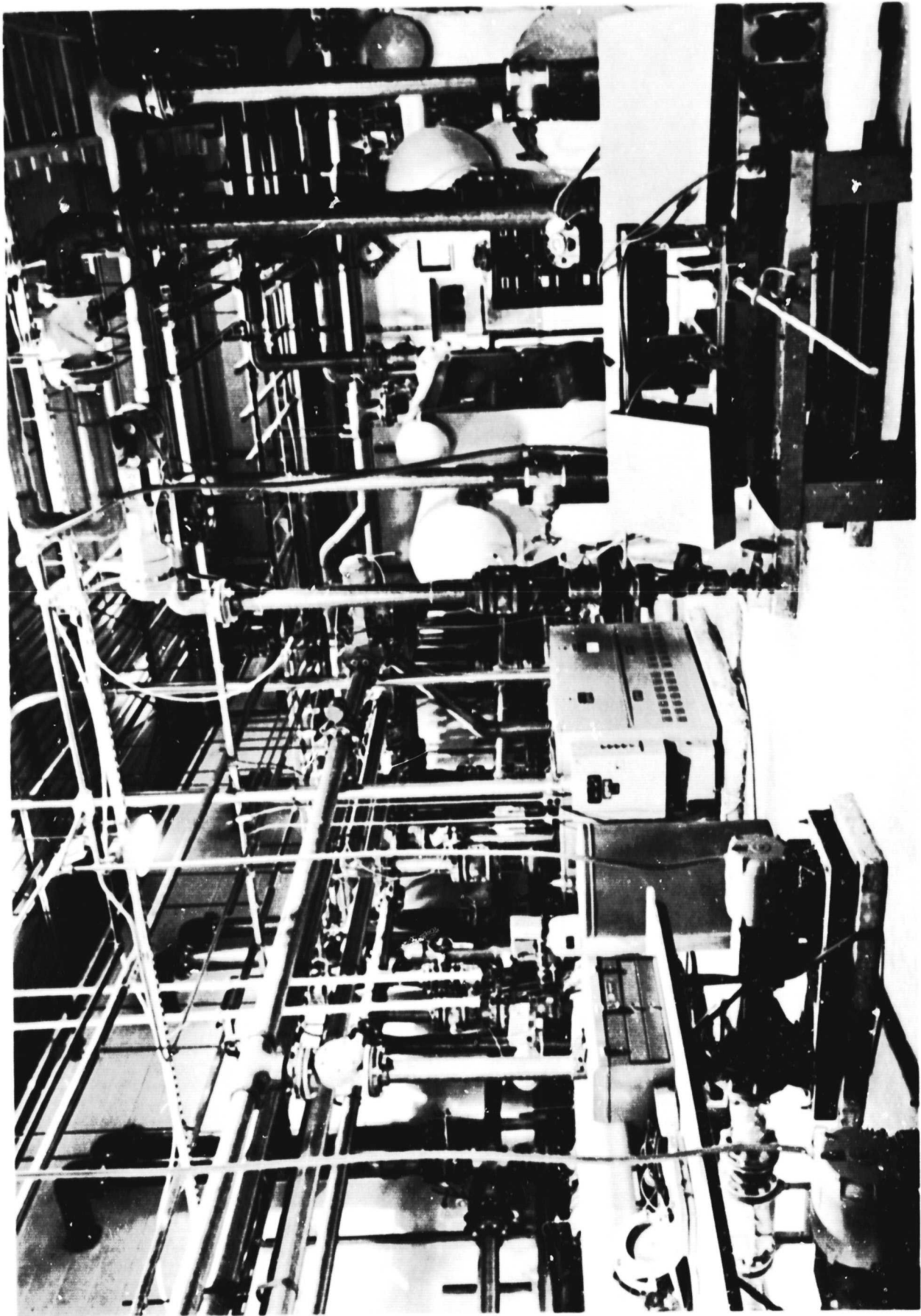
Solar hot/cool water heat  
exchanger Air handling unit  
with automatic Control Valves



PICTURE PLATE #6

RKL Controls

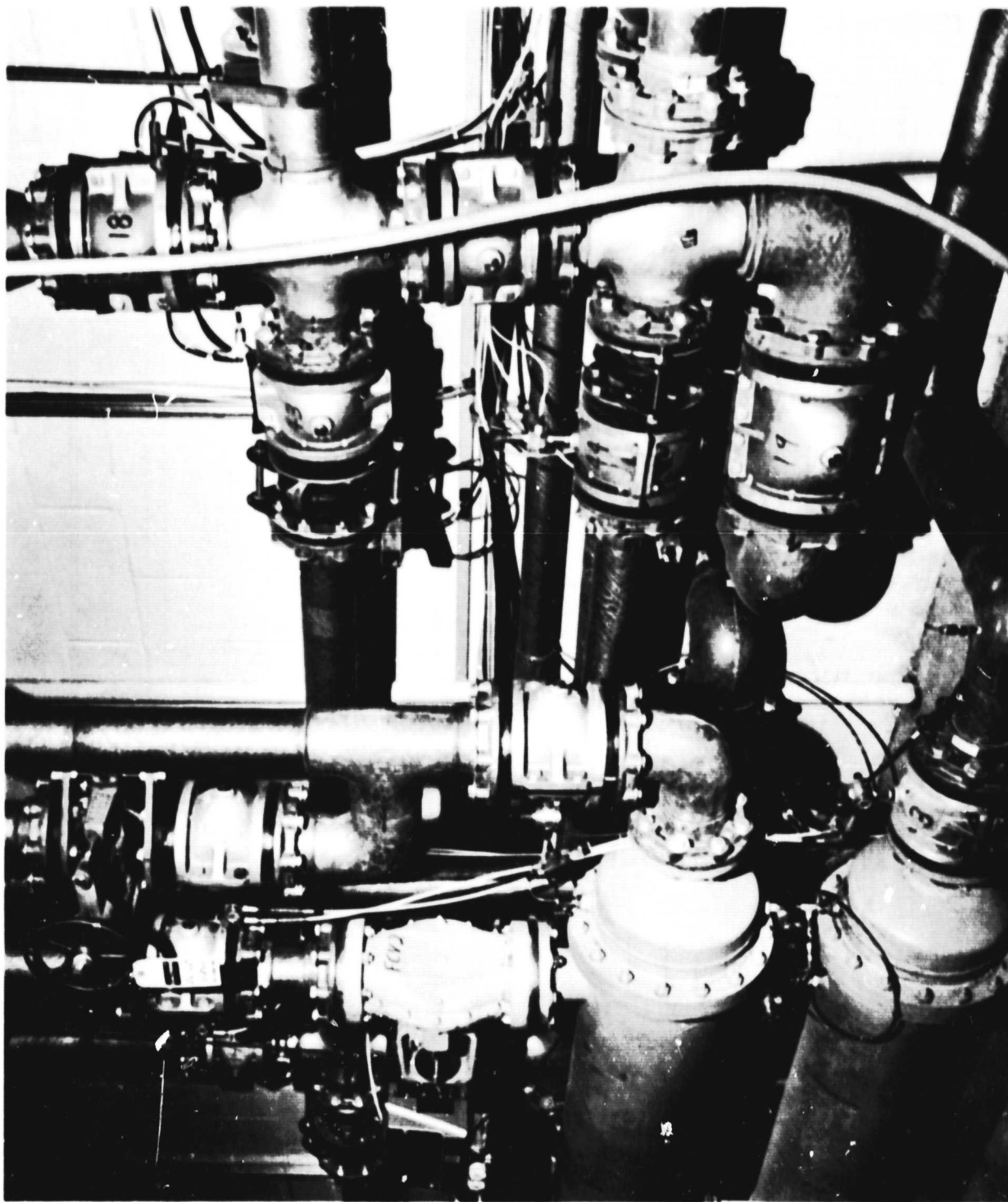
Solar Mechanical Room  
Pump Alley looking South



PICTURE PLATE #7

RKL Controls      Solar Mechanical Room  
showing Valving, Piping,  
Chillers and Auxillary Boiler

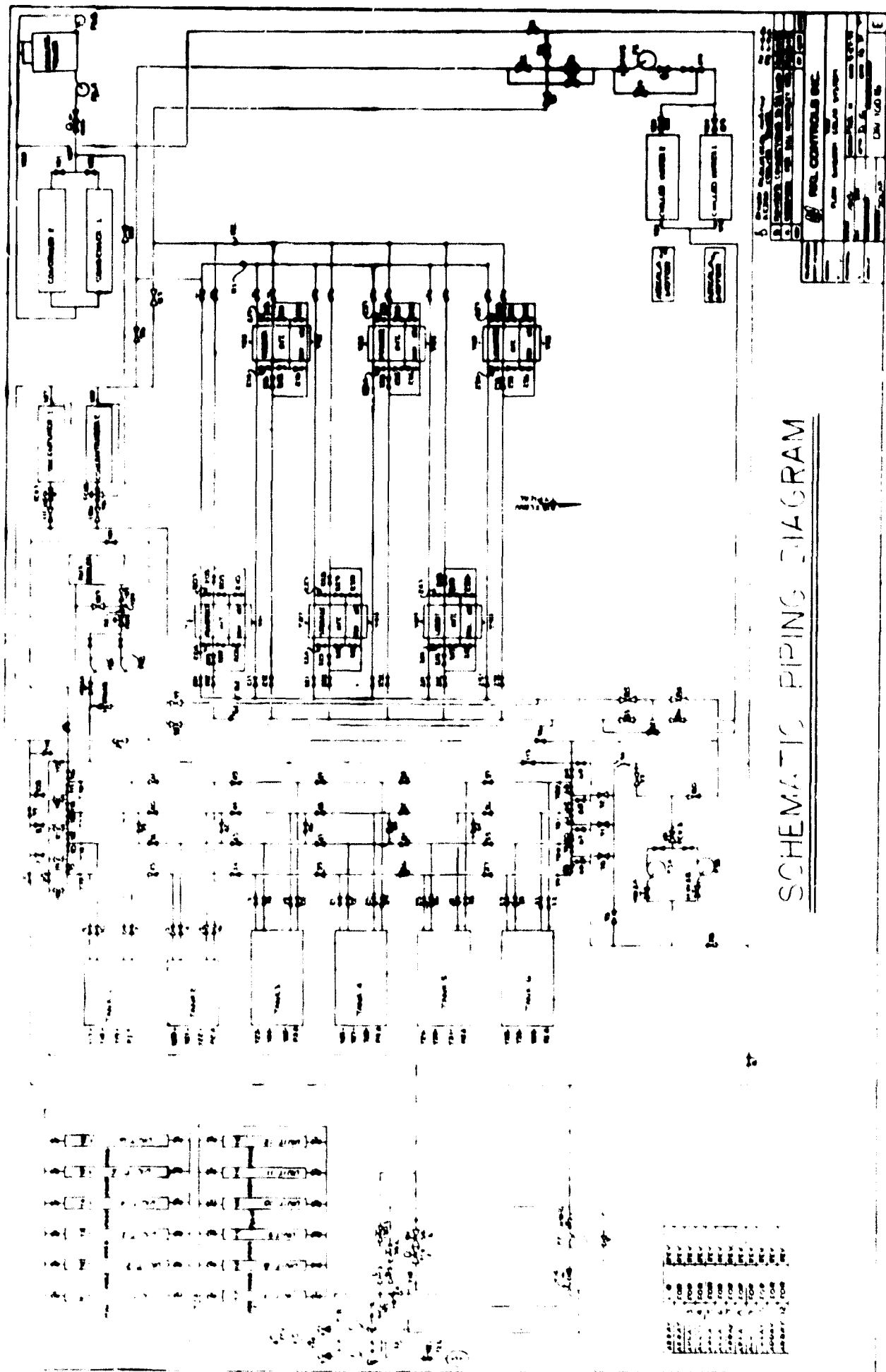




PICTURE PLATE #8

RKL Controls

Solar Mechanical Room - Section  
of East wall showing Piping, Control  
Valves, and end of Solar Loop Heat  
Exchanger.



SCHEMATIC PIPING DIAGRAM

|   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |     |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|

# Typical Temperature

## Printout

TIMEVSC = 6720

| SENSOR NUMBERS    | LOCATION                               | DEGREES F |
|-------------------|--|-----------|
| T73               | SOLAR LOOP---OUTLET . . . . .          | 57.0      |
| T14               | PUMPS 1A AND 1B DISCHARGE . . . . .    | 51.8      |
| T15               | HEAT EXCHANGER---SHELL OUT . . . . .   | 65.6      |
| T16               | HEAT EXCHANGER---SHELL IN . . . . .    | 64.9      |
| AVE T17, T18, T19 | TANK 1 . . . . .                       | 89.4      |
| AVE T20, T21, T22 | TANK 2 . . . . .                       | 113.3     |
| AVE T23, T24, T25 | TANK 3 . . . . .                       | 96.4      |
| AVE T26, T27, T28 | TANK 4 . . . . .                       | 100.0     |
| AVE T29, T30, T31 | TANK 5 . . . . .                       | 94.1      |
| AVE T32, T33, T34 | TANK 6 . . . . .                       | 97.0      |
| AVE T47, T48, T49 | ASSEMBLY AIR TEMPERATURE . . . . .     | 67.9      |
| AVE T50, T51, T52 | RUBBER AIR TEMPERATURE . . . . .       | 67.6      |
| AVE T65, T66, T67 | OFFICE AIR TEMPERATURE . . . . .       | 69.2      |
| AVE T69, T70, T71 | MACHINE SHOP AIR TEMPERATURE . . . . . | 68.4      |
| T41 - T35         | DT ASSEMBLY AIR HANDLER . . . . .      | 12.8      |
| T42 - T36         | DT RUBBER AIR HANDLER . . . . .        | 1.4       |
| T43 - T37         | DT STOCKROOM AIR HANDLER . . . . .     | 5.3       |
| T44 - T38         | DT MACHINE SHOP AIR HANDLER . . . . .  | 2.9       |
| T45 - T39         | DT LOBBY AIR HANDLER . . . . .         | 4.4       |
| T46 - T40         | DT LUNCHROOM AIR HANDLER . . . . .     | 10.2      |

0 = TANK 0

0 = TANK 1

THE NUMBER PRECEDING TANK 0 AND TANK 1 ARE THE RESPECTIVE TANK THAT WATER IS BEING USED TO HEAT THE BUILDING AND WATER IS BEING USED TO STORE HEAT. A ZERO (0) INDICATES THAT THIS PARTICULAR FUNCTION IS NOT IN OPERATION AT THIS TIME.

## PROCEDURE FOR MANUALLY OPERATING THE RKL SOLAR SYSTEM

As it is desirable at certain times to operate the system manually when computers are being serviced or maintenance is taking place in different parts of the system, we determined from the beginning that there would be a manual system for the basic collection, storage and distribution for both the heating and cooling modes.

To accomplish this manual operation a series of toggle switches were placed under a locked cover to the right of the operator at our solar computer console. These toggle switches allow us to bypass the computer at any time if the need arises. These switches are shown in picture plate No. 4.

The following computer printouts are instruction to an operator which are self-explanatory to handle any of the manual override that might be desired.



# PROCEDURE FOR OBTAINING SYSTEM TEMPERATURES

- 1) TURN ON SIGNAL CONDITIONER FOR DISK DRIVES.
- 2) TURN ON LOWER CROMEMCO Z2 MICRO-PROCESSOR.
- 3) TURN ON LEAR SEIGLER ADM 3 CRT FOR DISPLAY.
- 4) INSERT DISK E2 INTO RIGHT HAND DISK DRIVE---  
LABEL FACING LEFT---LEFTMOST SLOT ON DRIVE.
- 5) PUSH RESET BUTTON ON LOWER CROMEMCO Z2 PROCESSOR.
- 6) PUT SWITCH, SECOND FROM BOTTOM ON LEFT SIDE  
OF OPTO-22 BOX IN THE UP POSITION.
- 7) PUSH THE RETURN BUTTON ON THE CRT KEYBOARD  
SEVERAL TIMES.
- 8) THE COMPUTER WILL PROMPT THE USER WITH THE  
FOLLOWING PHRASES

CROMEMCO RDOS1

- 9) TO THIS THE USER SHOULD RESPOND WITH A D  
FOLLOWED BY A CARRIAGE RETURN.
- 10) THIS TIME, THE COMPUTER WILL RESPOND WITH THE  
FOLLOWING:

CDOS VERSION 02.17  
CROMEMCO DISK OPERATING SYSTEM  
COPYRIGHT (C) 1970,1979 CROMEMCO, INC.

A.

- 11) THE COMPUTER IS NOW READY TO EXECUTE A PROGRAM.  
THE ONLY PROGRAMS THAT IT CAN DIRECTLY EXECUTE, ARE  
THOSE WITH A FILENAME ENDING WITH A 'COM' EXTENSION.
- 12) TYPE IN LOOK3 AND FOLLOWED BY A CARRIAGE RETURN.
- 13) DISPLAY SHOULD APPEAR WITHIN 30 SECONDS.
- 14) TO MOMENTARILY HALT THE DISPLAY'S SCROLLING ACTION,  
A CONTROL-S CAN BE USED. THIS IS ACCOMPLISHED BY  
DEPRESSING THE CTRL KEY AND WHILE HOLDING THIS KEY,  
DEPRESSING THE S KEY.
- 15) TO ABORT THE DISPLAY USE A CONTROL-C. TO PRINT OUT  
THE DISPLAY USE A CONTROL-P.
- 16) RESTART DISPLAY BY TYPING A CONTROL-S AGAIN. TO STOP  
THE PRINTING OF THE DISPLAY, TYPE A CONTROL-P.

ORIGINAL PAGE IS  
OF POOR QUALITY

10-3-00

# COLLECTING AND STORAGE LOOP INSTRUCTIONS

=====

- 1) OPEN CV 125
- 2) OPEN SURGE TANK BALL VALVE
- 3) TURN ON PUMP 1A AND 1B
- 4) PUT ARRAYS IN THE COLLECT POSITION
- 5) WHEN T73 AND T14 ARE GREATER THAN 60 F OPEN CV 3 AND 4
- 6) CLOSE CV 125
- 7) OPEN CV 1,3,120,110,33,34,35,36,37,40,44,40,52,56
- 8) DETERMINE DESIRED TANK FOR STORAGE.
- 9) VALVE TO THAT TANK USING THE FOLLOWING VALVES
  - A) TANK1 -- CV 9 & 11
  - B) TANK2 -- CV 13 & 15
  - C) TANK3 -- CV 17 & 19
  - D) TANK4 -- CV 21 & 23
  - E) TANK5 -- CV 25 & 27
  - F) TANK6 -- CV 29 & 31
- 10) WHEN THE LOOP TEMPERATURE (IE. T13, T14, AND T73) IS GREATER THAN THE SELECTED TANK TEMPERATURE, TURN ON PUMP 2.
- 11) AT THE END OF THE DAY, OR WHEN CONDITIONS DICTATE (IE. SNOW, WIND, MECHANICAL PROBLEM, ETC.), THE FOLLOWING PROCEDURE SHOULD BE USED TO SHUTDOWN THE SYSTEM.
- 11) TURN OVER ARRAYS
- 12) TURN OFF PUMP 1A, 1B, AND 2
- 13) CLOSE CV 125,1,3,120,3,4,110,33,34,35,36,37,40,44,40,52,56  
9,11,13,15,17,19,21,23,25,27,29,31
- 14) CLOSE SURGE TANK BALL VALVE.

B.

10-3-00

# HEATING OF PLANT AND OFFICES =====

- 1) DETERMINE SOURCE OF HEAT.  
IE. SOLAR LOOP OR STORAGE.
- 2) IF SOURCE IS SOLAR LOOP,
  - A) OPEN CV 99,96,79,1,65,115,112
  - B) CHECK AIR HANDLER INSTRUCTIONS TO DETERMINE AIR HANDLER VALVES THAT ARE TO BE OPENED.
  - C) OPEN THOSE VALVES
  - D) TURN ON PUMP 2.
  - E) WHEN A COMFORTABLE TEMPERATURE HAS BEEN REACHED, SET UP MODE TO STORE SOLAR LOOP HEAT IN A TANK.
- 3) IF SOURCE IS TANK STORAGE,
  - A) OPEN CV 83,84,80,66,59,55,51,47,43,38,41,45  
49,53,57,63,72,74,91, AND 93.
  - B) CHECK AIR HANDLER INSTRUCTIONS TO DETERMINE AIR HANDLER VALVES THAT ARE TO BE OPENED.
  - C) OPEN THOSE VALVES
  - D) DETERMINE TANK THAT IS DESIRED TO BE USED.
    - 1) TANK 1 OPEN CV 10 & 12
    - 2) TANK 2 OPEN CV 14 & 16
    - 3) TANK 3 OPEN CV 18 & 20
    - 4) TANK 4 OPEN CV 22 & 24
    - 5) TANK 5 OPEN CV 26 & 28
    - 6) TANK 6 OPEN CV 30 & 32
  - E) OPEN THOSE VALVES FOR THE TANK DESIRED.
  - F) TURN ON PUMP 3A AND 3B.
  - G) WHEN A COMFORTABLE TEMPERATURE HAS BEEN REACHED, TURN OFF PUMP 3A AND 3B.

11-3-80

## AIR HANDLER CONTROL DIRECTIONS

\*\*\*\*\*

THE AIR HANDLERS ARE TO BE SET UP IN THE FOLLOWING MANNER USING THEM FOR TANK TO AIRHANDLER HEAT AND SOLAR LOOP TO HEAT EXCHANGER TO AIR HANDLER PREHEAT MODES. THE VALVING TO THE AIR HANDLER BUSES IS ACCOMPLISHED IN SHEET SETTING UP THE HEATING MODE DISTRIBUTION LOOP. THIS SHEET ONLY DESCRIBES THE SETTING OF THE VALVES ON THE AIR HANDLERS THEMSELVES.

THE AIR HANDLER VALVES CAN BE DESCRIBED IN THE FOLLOWING MANNER:

XX Y

XX -- THE TWO NUMBER VALVE PREFIX  
Y -- THE ONE NUMBER VALVE SUFFIX

THE PREFIXES DETERMINE THE AIR HANDLER THAT IS BEING USED, AND THE SUFFIXES DETERMINE THE ACTUAL BANKS ON THAT AIR HANDLER THAT ARE BEING ACTIVATED, THESE ARE DIFFERENT WHETHER ONE IS USING THE PREHEAT OR HEAT MODE VALVE CHARTS.

THE BANK AND AIR HANDLER SELECTIONS FOLLOW:

### AIR HANDLERS:

20Y -- ASSEMBLY  
21Y -- RUBBER  
22Y -- STORAGE  
23Y -- MACHINE  
24Y -- LOBBY  
25Y -- LUNCHROOM

### BANKS (PREHEAT MODE):

BANK1: XX1  
BANK2: XX1, XX4  
BANK3: XX1, XX4, XX5  
BANK4: XX1, XX4, XX5, XX6

### BANKS (HEATING MODE):

BANK1: XX2  
BANK2: XX2, XX6  
BANK3: XX2, XX6, XX5  
BANK4: XX2, XX6, XX5, XX4

IN THE PREVIOUS INFORMATION, IT MUST BE RECOGNIZED THAT THE BANKS ARE ADDITIVE AND THAT BANK ONE MUST BE ACTIVATED BEFORE BANK TWO AND TWO BEFORE THREE AND SO ON; AND THAT THE TOTAL NUMBER OF BANKS TO BE ACTIVATED ON ANY INDIVIDUAL AIR HANDLER CANNOT EXCEED FOUR (4).

## EXAMPLES OF AIR HANDLER AND BANK SELECTION

EXAMPLE 1: THE AIR TEMPERATURE IN THE RUBBER AREA IS 63 F AND THERE HAVE BEEN NUMEROUS COMPLAINTS ABOUT IT BEING TOOOOOOOOOOOOOOOOOOOOOOOOOO CCCCCOLD. THE FIRST THING THAT HAS TO BE DONE IS TO DETERMINE WHICH TANK IS TO BE USED TO HEAT THE BUILDING. WHEN THIS IS DONE, THE OPERATOR MUST DETERMINE HOW MANY OF THE BANKS AND WHICH AIR HANDLER IS TO BE USED. THIS IS DONE BY CHECKING ON THE PAGE TITLED AIR HANDLER CONTROL DIRECTIONS.

FIRST, FIND THE TWO NUMBER VALVE PREFIX TO FIND THIS, ONE CHECKS THE AREA TITLED AIR HANDLERS. FROM THIS IT IS DETERMINED THAT THE PREFIX SHOULD BE 21 (21Y).

SECOND, FIND THE ONE NUMBER VALVE SUFFIX(ES) NEEDED TO COMPLETE THE VALVE NUMBERS. ASSUME FOR NOW THAT THREE BANKS ARE NEEDED TO AFFECT A REASONABLE TEMPERATURE RISE IN THAT AREA. ONE NOW CHECKS THE TITLE BANKS (HEATING MODE): AND FINDS THAT XX2, XX6, AND XX5 ARE NEEDED.

THIRD, THE OPERATOR COMBINES THESE NUMBERS IN THE FOLLOWING MANNER:

XXY

XX = 21  
Y = 2, 6, AND 5

SO THAT THE RESULTING VALVE NUMBERS ARE AS FOLLOWS:

212  
216  
215

# PROCEDURE FOR MANUAL CONTROL OF ARKLA CHILLERS

=====

- 1) OPEN CV 13,11,120,8,1,110,5,6,33
- 2) TURN ON PUMP 1A AND 1B.
- 3) TURN UP ARRAYS
- 4) WAIT EXACTLY NINE (9) MINUTES
- 5) OPEN CV 9. CLOSE CV 13,33
- 6) OPEN CV 79,111,106,109,115,65
- 7) AFTER 20 SECONDS CLOSE CV 110 & 9
- 8) CLOSE CV 8,120,11
- 9) TURN ON BOILER
- 10) WHEN T55,T56,T73,T14 ARE ALL GREATER THAN 160 F
  - A) OPEN CV 88,89,95,86,85,101,102
  - B) SELECT AIR HANDLER VALVES TO BE OPENED FROM THE PAGE TITLED AIR HANDLER CONTROL DIRECTIONS AND THE PARTICULAR BANK OR BANKS THAT ARE TO BE USED FROM THE BANKS (HEATING MODE): OPEN OF THE PAGE.
  - C) TURN ON PUMP 5
- 11) WHEN T55,T56,T73,T14 ARE ALL GREATER THAN 165 F, TURN ON ARKLA 1 AND ARKLA 2.

NOTE: PERMANENT IRREPARABLE DAMAGE WILL OCCUR IF THE CHILLERS ARE RUN AT LOWER THAN 160 F HOT WATER INLET TEMPERATURES. THIS DAMAGE WILL BE CAUSED IMMEDIATELY BECAUSE OF THE NATURE OF THE EQUIPMENT. THE OPERATOR SHOULD KEEP THIS IN MIND WHEN OPERATING THIS EQUIPMENT!!!!!!!!!!

- 12) WHEN COLLING IS NO LONGER NEEDED:
  - A) TURN OFF ARKLAS
  - B) WAIT 2 MINUTES (IMPORTANT)
  - C) TURN OFF BOILER
  - D) OPEN CV 9,11,120,110,8
  - E) CLOSE CV 65,79,111,106,102,101,115
  - F) TURN OVER ARRAYS
  - G) OPEN CV 15,40: CLOSE CV 11
  - H) AFTER EXACTLY NINE (9) MINUTES
    - 1) TURN OFF PUMP 1A AND 1B
    - 2) CLOSE CV 15,40,9,110,8,120,1,5,6
  - I) TURN OFF PUMP 5
  - J) CLOSE CV 88,89,95,86,85, AND ALL AIR HANDLER VALVES. (IE. THOSE OF THE 200 SERIES)

# PROCEDURE FOR STORAGE OF CHILLED WATER

- 1) OPEN CV 13,11,120,3,1,110,5,6,33  
 2) TURN ON PUMP 1A AND 1B.  
 3) TURN UP ARRAYS  
 4) WAIT EXACTLY NINE (9) MINUTES  
 5) OPEN CV 9, CLOSE CV 13,33  
 6) OPEN CV 79,111,106,109,115,65  
 7) AFTER 20 SECONDS CLOSE CV 110 & 9  
 8) CLOSE CV 3,120,11  
 9) TURN ON BOILER  
 10) WHEN T55,T56,T73,T14 ARE ALL GREATER THAN 160 F  
 A) OPEN CV 33,39,90,93,73,63,43,52,56,35,36,37,  
 53,70,74,34,36  
 B) CHOOSE TANK VALVES FROM THE FOLLOWING LIST:  
 1) TANK 3: CV 17 & 19  
 2) TANK 4: CV 21 & 23  
 3) TANK 5: CV 25 & 27  
 4) TANK 6: CV 29 & 31  
 C) TURN ON PUMP 5  
 11) WHEN T55,T56,T73,T14 ARE ALL GREATER THAN 165 F, TURN  
 ON ARKLA 1 AND ARKLA 2.
- NOTE:** PERMANENT IRREPARABLE DAMAGE WILL OCCUR IF  
 THE CHILLERS ARE RUN AT LOWER THAN 160 F  
 HOT WATER INLET TEMPERATURES.  
 THIS DAMAGE WILL BE CAUSED IMMEDIATELY  
 BECAUSE OF THE NATURE OF THE EQUIPMENT.  
 THE OPERATOR SHOULD KEEP THIS IN MIND WHEN  
 OPERATING THIS EQUIPMENT!!!!!!!!!!!!
- 12) WHEN COLLING IS NO LONGER NEEDED:  
 A) TURN OFF ARKLAS  
 B) WAIT 2 MINUTES (IMPORTANT)  
 C) TURN OFF BOILER  
 D) OPEN CV 9,11,120,110,3  
 E) CLOSE CV 65,79,111,106,102,101,115  
 F) TURN OVER ARRAYS  
 G) OPEN CV 15,40; CLOSE CV 11  
 H) AFTER EXACTLY NINE (9) MINUTES  
 1) TURN OFF PUMP 1A AND 1B  
 2) CLOSE CV 15,40,9,110,3,120,1,5,6  
 I) TURN OFF PUMP 5  
 J) CLOSE CV 33,39,90,93,73,63,43,52,56,35,36,37,  
 53,70,74,34,36,17,19,21,23,25,27,29,31

ORIGINAL PAGE IS  
 OF POOR QUALITY

11-4-00

# DISTRIBUTION OF CHILLED WATER FROM TANK TO AIR HANDLERS

- 1) DETERMINE IF THE TEMPERATURE IN A TANK IS LESS THAN THE AIR TEMPERATURE IN THE BUILDING BY TWENTY OR MORE DEGREES F. IF THERE IS SUFFICIENT DIFFERENTIAL TEMPERATURE, PROCEED.
- 2) OPEN CV 41,45,49,53,57,33,43,47,51,55,63,68,80,92,93, 34,35,74,70,59
- 3) CHOOSE TANK VALVES FOR USE OF STORED WATER IN A TANK. IN THE FOLLOWING CHART, ONE CAN DETERMINE THE VALVES THAT IT WOULD BE NECESSARY TO OPERATE IN ORDER TO UTILIZE THE TANK WHICH WAS CHOSEN.
  - A) TANK 1 OPEN CV 10 & 12
  - B) TANK 2 OPEN CV 14 & 16
  - C) TANK 3 OPEN CV 18 & 20
  - D) TANK 4 OPEN CV 22 & 24
  - E) TANK 5 OPEN CV 26 & 28
  - F) TANK 6 OPEN CV 30 & 32
- 4) CHOOSE AIR HANDLER VALVES THAT ARE TO BE OPERATED. THIS IS DONE BY CHECKING ON THE PAGE TITLED "AIR HANDLER CONTROL DIRECTIONS". THE ACTUAL BANKS CAN BE FOUND BY USING THE SECTION TITLED "BANKS (PREHEAT MODE):".
- 5) AFTER ALL VALVE SETTINGS HAVE BEEN ACCOMPLISHED, PUMPS 3A AND 3B CAN BE ACTIVATED.
- 6) WHEN THE TANK HAS BEEN EXHAUSTED, OR THE PLANT HAS BECOME COOL ENOUGH, TURN OFF PUMP 3A AND 3B, VALVE TO A NEW TANK OR CLOSE DISTRIBUTION VALVES AS THE CASE MAY BE.



11-4-00

**PROCEDURE FOR MANUAL OPERATION OF AUXILIARY COOLING**  
=====

- 1) OPEN CV 12,116,114,109,111,106
- 2) TURN ON PUMP 1A AND PUMP 1B.
- 3) TURN ON AUXILIARY WATER HEATER
- 4) WHEN T55 AND T56 ARE BOTH GREATER THAN 160 F:
  - A) OPEN CV 33,39,95,36,35,101,102
  - B) SELECT AIR HANDLER VALVES TO BE OPENED FROM THE PAGE TITLED AIR HANDLER CONTROL DIRECTIONS AND THE PARTICULAR BANK OR BANKS THAT ARE TO BE USED FROM THE BANKS (HEATING MODE): AREA OF THE PAGE.
  - C) TURN ON PUMP 5
- 5) WHEN T55 AND T56 ARE BOTH GREATER THAN 165 F, TURN ON ARKLA 1 AND ARKLA 2.

**NOTE:** PERMANENT IRREPARABLE DAMAGE WILL OCCUR IF THE CHILLERS ARE RUN AT LOWER THAN 160 F HOT WATER INLET TEMPERATURES. THIS DAMAGE WILL BE CAUSED IMMEDIATELY BECAUSE OF THE NATURE OF THE EQUIPMENT. THE OPERATOR SHOULD KEEP THIS IN MIND WHEN OPERATING THIS EQUIPMENT!!!!!!!!!!!!

- G) WHEN COOLING IS NO LONGER NEEDED:
  - A) TURN OFF ARKLAS
  - B) WAIT 2 MINUTES (IMPORTANT)
  - C) TURN OFF AUXILIARY WATER HEATER
  - D) TURN OFF PUMPS 1A AND 1B.
  - E) CLOSE CV 12,116,114,109,111,106
  - F) TURN OFF PUMP 5
  - G) CLOSE CV 101,102,33,39,95,36,35, AND ALL AIR HANDLER VALVES. (IE. THOSE OF THE 200 SERIES)

## MAINTENANCE BULLETIN FOR RKL DESIGNED SOLAR COLLECTING SUB-ARRAY

1. Twice yearly at the time of changeover from water to propylene glycol or from propylene glycol to water in the early spring or late fall the one horse power one rpm, double reduction gear motor should be checked for lubricant level.
2. Twice a year the oil cups on the top of the bearing at either end of the sub-array shaft should be checked for grease capacity.
3. The safety releif valves located on the collector discharge header should be checked for pressure setting and ease of operation and tight sealing at least twice a year.
4. Check all tie-down bolts on each leg of the A-frame support once a year for tightness of the hold-down clamps.
5. Check the drive chain from the gear motor drive to the shaft for lubrication twice a year. It should be lubricated with a heavy molly-type sprayon lubricant.

6. Check all hose connections for possible leakage and deterioration at least once a week.
7. Check and repair insulation of the two inch diameter hose from each header to each collector loop for fraying and cutting, and repair once every fall.
8. Check the keyway on the drive motor shaft and the spurgear lockset every four months for tightness.
9. Clean collector glass twice a year during switch over from heating to cooling and cooling to heating.

### Typical Operation Modes

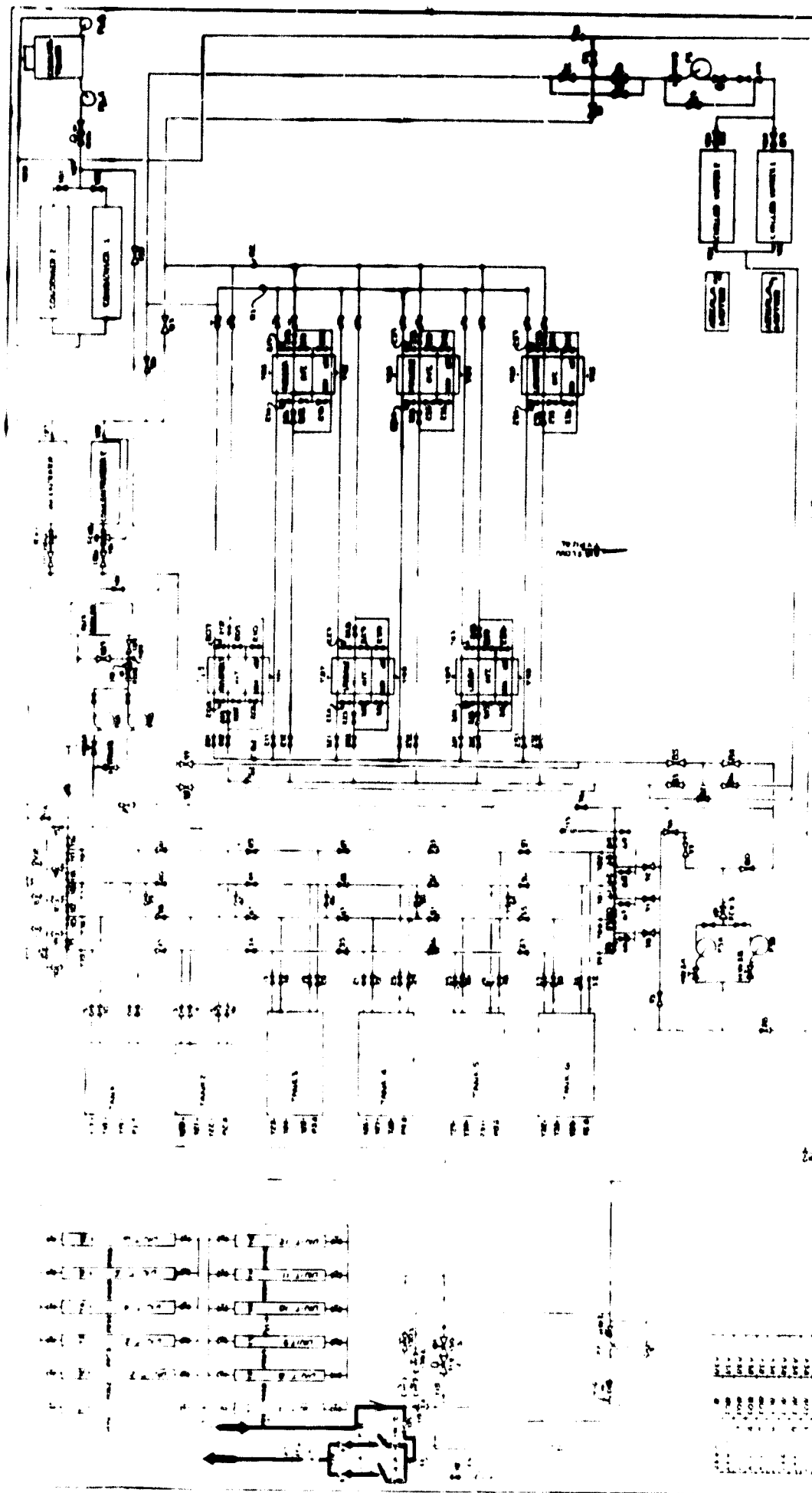
#### Heating Season

#### Flow Dia. Plate #

|                                     |   |
|-------------------------------------|---|
| Pre Heat Mode                       | 1 |
| Solar Collection to Storage         | 2 |
| Storage to Plant Air Handling Units | 3 |
| Auxillary to Storage                | 4 |

#### Cooling Season

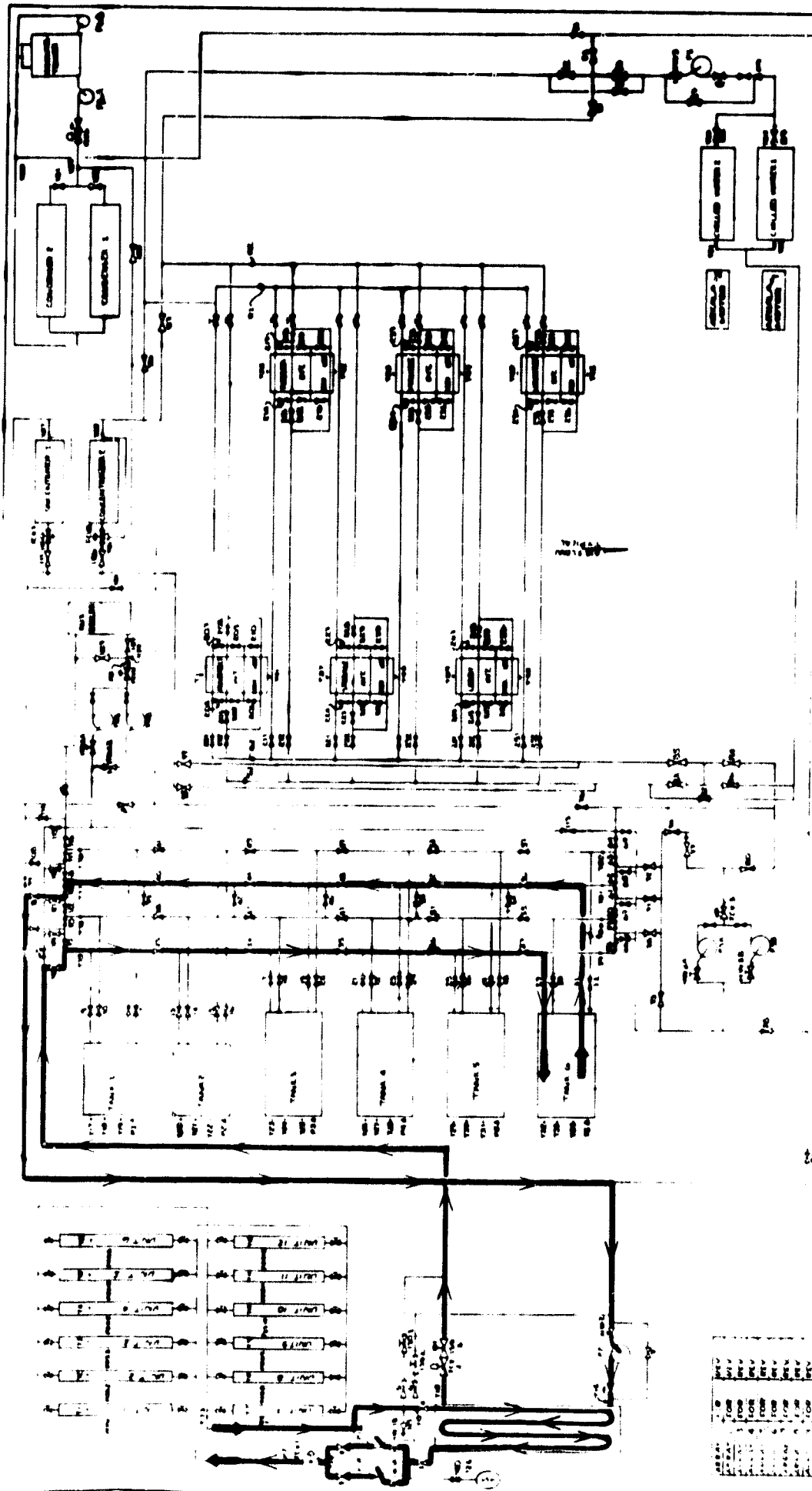
|                                      |   |
|--------------------------------------|---|
| Solar Collection to Hot Storage      | 2 |
| Hot Storage to Chillers              | 5 |
| Chillers to Storage                  | 6 |
| Chillers to Plant Air Handling Units | 7 |
| Hot Auxillary to Chillers            | 8 |
| Solar Collection to Chillers         | 9 |



PRE HEAT MODE

FLOW DIA PLATE #1

|                  |                  |                  |                  |                  |                  |                  |                  |                  |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                    |
|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|--------------------|
| 1. PRE HEAT MODE | 2. PRE HEAT MODE | 3. PRE HEAT MODE | 4. PRE HEAT MODE | 5. PRE HEAT MODE | 6. PRE HEAT MODE | 7. PRE HEAT MODE | 8. PRE HEAT MODE | 9. PRE HEAT MODE | 10. PRE HEAT MODE | 11. PRE HEAT MODE | 12. PRE HEAT MODE | 13. PRE HEAT MODE | 14. PRE HEAT MODE | 15. PRE HEAT MODE | 16. PRE HEAT MODE | 17. PRE HEAT MODE | 18. PRE HEAT MODE | 19. PRE HEAT MODE | 20. PRE HEAT MODE | 21. PRE HEAT MODE | 22. PRE HEAT MODE | 23. PRE HEAT MODE | 24. PRE HEAT MODE | 25. PRE HEAT MODE | 26. PRE HEAT MODE | 27. PRE HEAT MODE | 28. PRE HEAT MODE | 29. PRE HEAT MODE | 30. PRE HEAT MODE | 31. PRE HEAT MODE | 32. PRE HEAT MODE | 33. PRE HEAT MODE | 34. PRE HEAT MODE | 35. PRE HEAT MODE | 36. PRE HEAT MODE | 37. PRE HEAT MODE | 38. PRE HEAT MODE | 39. PRE HEAT MODE | 40. PRE HEAT MODE | 41. PRE HEAT MODE | 42. PRE HEAT MODE | 43. PRE HEAT MODE | 44. PRE HEAT MODE | 45. PRE HEAT MODE | 46. PRE HEAT MODE | 47. PRE HEAT MODE | 48. PRE HEAT MODE | 49. PRE HEAT MODE | 50. PRE HEAT MODE | 51. PRE HEAT MODE | 52. PRE HEAT MODE | 53. PRE HEAT MODE | 54. PRE HEAT MODE | 55. PRE HEAT MODE | 56. PRE HEAT MODE | 57. PRE HEAT MODE | 58. PRE HEAT MODE | 59. PRE HEAT MODE | 60. PRE HEAT MODE | 61. PRE HEAT MODE | 62. PRE HEAT MODE | 63. PRE HEAT MODE | 64. PRE HEAT MODE | 65. PRE HEAT MODE | 66. PRE HEAT MODE | 67. PRE HEAT MODE | 68. PRE HEAT MODE | 69. PRE HEAT MODE | 70. PRE HEAT MODE | 71. PRE HEAT MODE | 72. PRE HEAT MODE | 73. PRE HEAT MODE | 74. PRE HEAT MODE | 75. PRE HEAT MODE | 76. PRE HEAT MODE | 77. PRE HEAT MODE | 78. PRE HEAT MODE | 79. PRE HEAT MODE | 80. PRE HEAT MODE | 81. PRE HEAT MODE | 82. PRE HEAT MODE | 83. PRE HEAT MODE | 84. PRE HEAT MODE | 85. PRE HEAT MODE | 86. PRE HEAT MODE | 87. PRE HEAT MODE | 88. PRE HEAT MODE | 89. PRE HEAT MODE | 90. PRE HEAT MODE | 91. PRE HEAT MODE | 92. PRE HEAT MODE | 93. PRE HEAT MODE | 94. PRE HEAT MODE | 95. PRE HEAT MODE | 96. PRE HEAT MODE | 97. PRE HEAT MODE | 98. PRE HEAT MODE | 99. PRE HEAT MODE | 100. PRE HEAT MODE |
|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|--------------------|

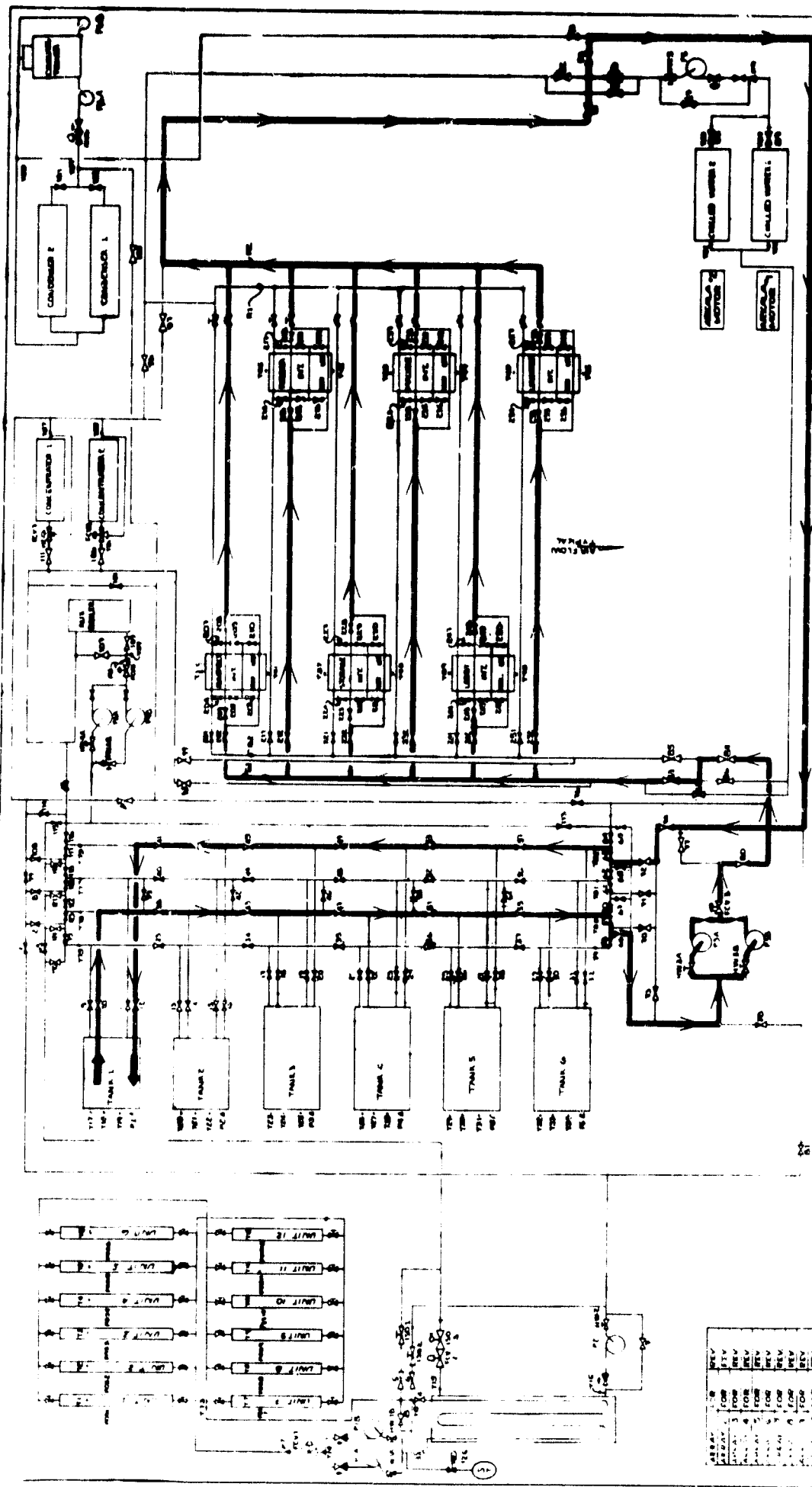


# SOLAR COLLECTION TO STORAGE

FLOW DIA PLATE # 2

|   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |     |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|

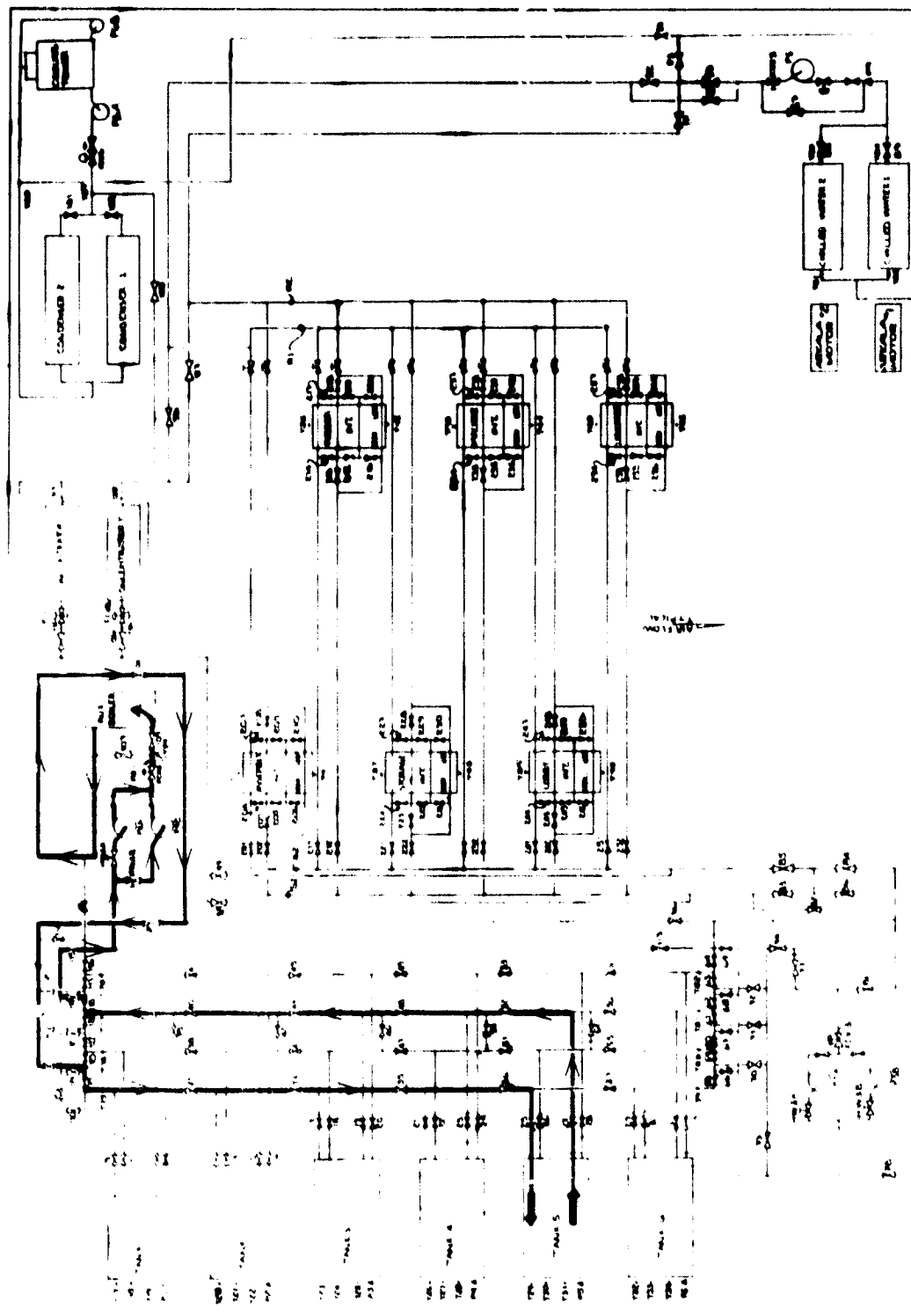
|   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |     |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|



# STORAGE TO AIR HANDLING UNITS

FLOW DIA PLATE # 3

|   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |     |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|

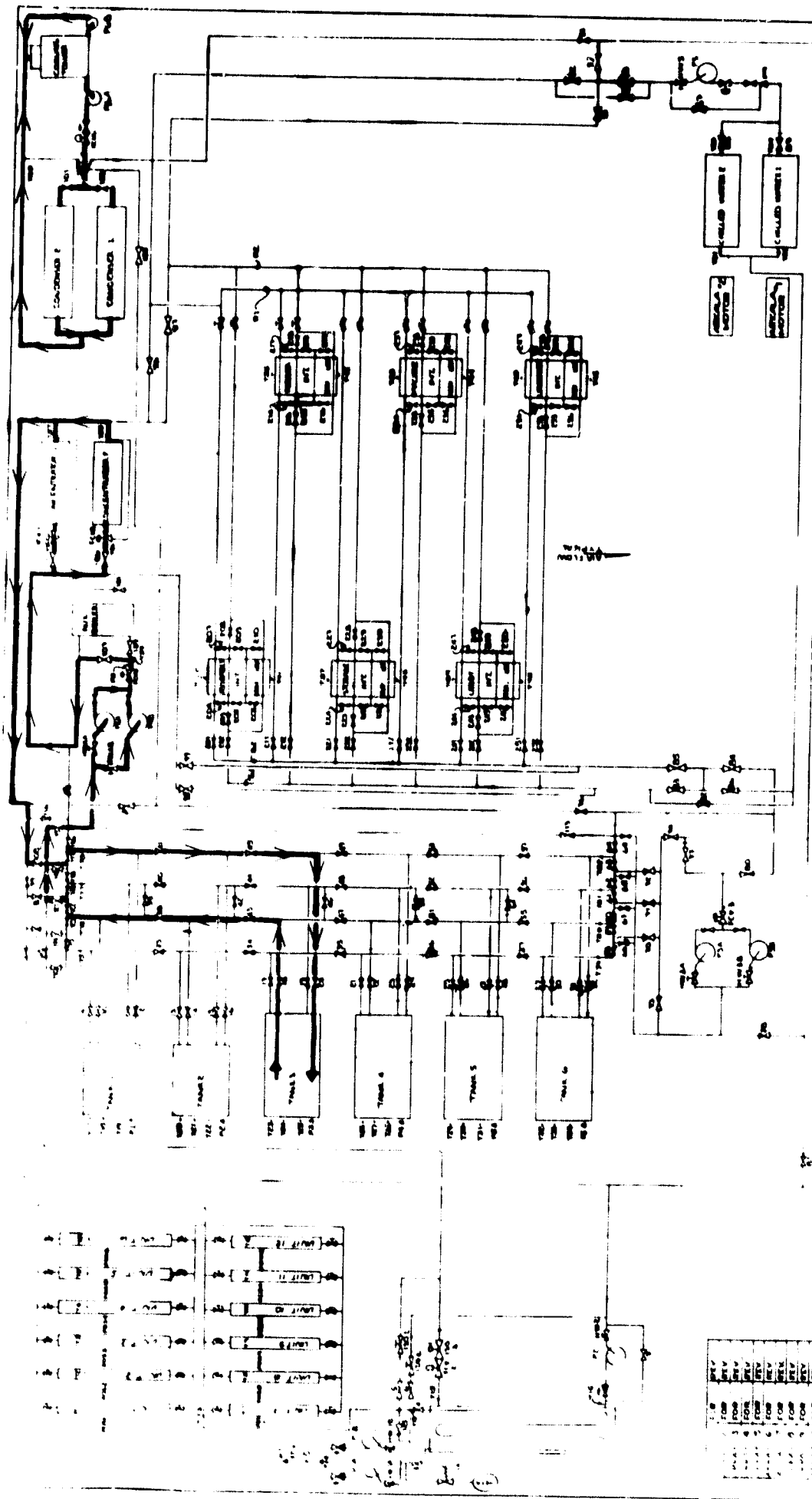


AUXILIARY TO STORAGE

FLOW DIA PLATE # 4

|                            |                             |
|----------------------------|-----------------------------|
| 1. Name of Project         | 2. Date                     |
| 3. Name of Engineer        | 4. Name of Designer         |
| 5. Name of Checker         | 6. Name of Approver         |
| 7. Name of Fabricator      | 8. Name of Installer        |
| 9. Name of Maintainer      | 10. Name of Operator        |
| 11. Name of Supervisor     | 12. Name of Manager         |
| 13. Name of Director       | 14. Name of President       |
| 15. Name of Vice President | 16. Name of Secretary       |
| 17. Name of Treasurer      | 18. Name of Auditor         |
| 19. Name of Legal Counsel  | 20. Name of Insurance Agent |
| 21. Name of Tax Advisor    | 22. Name of Bank            |
| 23. Name of Post Office    | 24. Name of City            |
| 25. Name of State          | 26. Name of Country         |
| 27. Name of Continent      | 28. Name of Planet          |
| 29. Name of Galaxy         | 30. Name of Universe        |



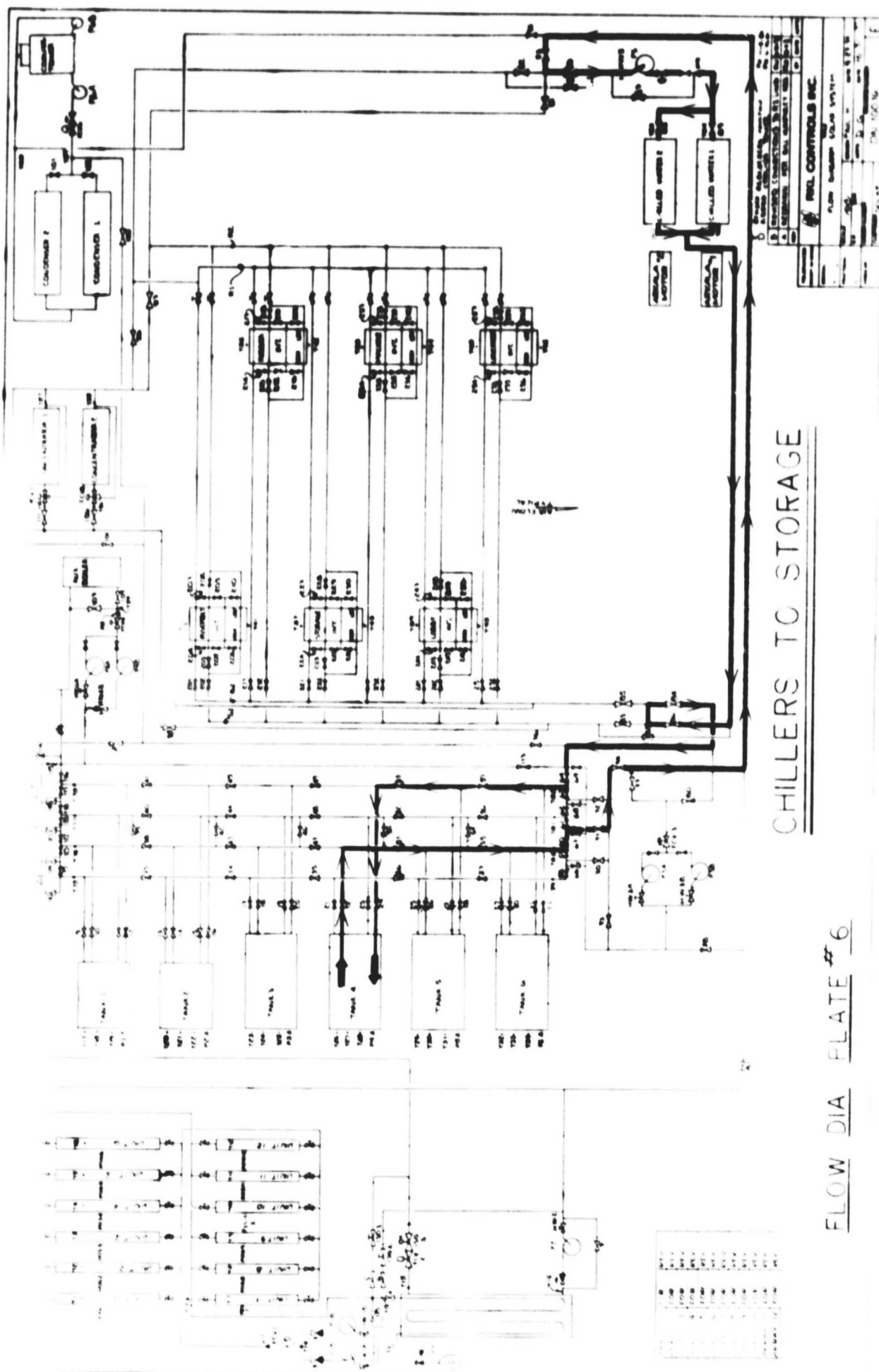


# HOT STORAGE TO CHILLERS

FLOW DIA PLATE #5

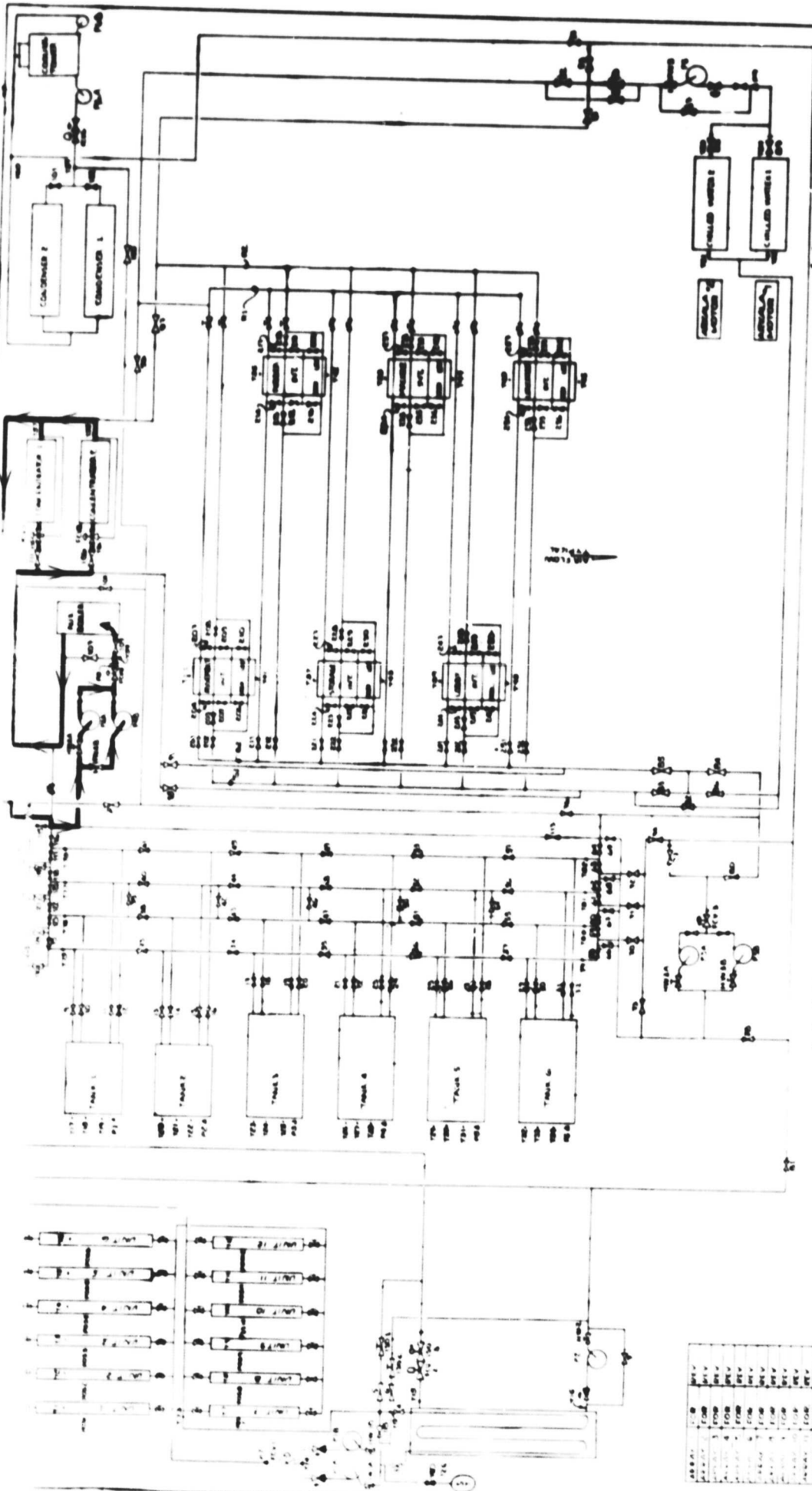
|    |                    |           |
|----|--------------------|-----------|
| 1  | REL. CONTROLS INC. | DN 100 lb |
| 2  | REL. CONTROLS INC. | DN 100 lb |
| 3  | REL. CONTROLS INC. | DN 100 lb |
| 4  | REL. CONTROLS INC. | DN 100 lb |
| 5  | REL. CONTROLS INC. | DN 100 lb |
| 6  | REL. CONTROLS INC. | DN 100 lb |
| 7  | REL. CONTROLS INC. | DN 100 lb |
| 8  | REL. CONTROLS INC. | DN 100 lb |
| 9  | REL. CONTROLS INC. | DN 100 lb |
| 10 | REL. CONTROLS INC. | DN 100 lb |

|    |                    |           |
|----|--------------------|-----------|
| 1  | REL. CONTROLS INC. | DN 100 lb |
| 2  | REL. CONTROLS INC. | DN 100 lb |
| 3  | REL. CONTROLS INC. | DN 100 lb |
| 4  | REL. CONTROLS INC. | DN 100 lb |
| 5  | REL. CONTROLS INC. | DN 100 lb |
| 6  | REL. CONTROLS INC. | DN 100 lb |
| 7  | REL. CONTROLS INC. | DN 100 lb |
| 8  | REL. CONTROLS INC. | DN 100 lb |
| 9  | REL. CONTROLS INC. | DN 100 lb |
| 10 | REL. CONTROLS INC. | DN 100 lb |



|   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |     |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|

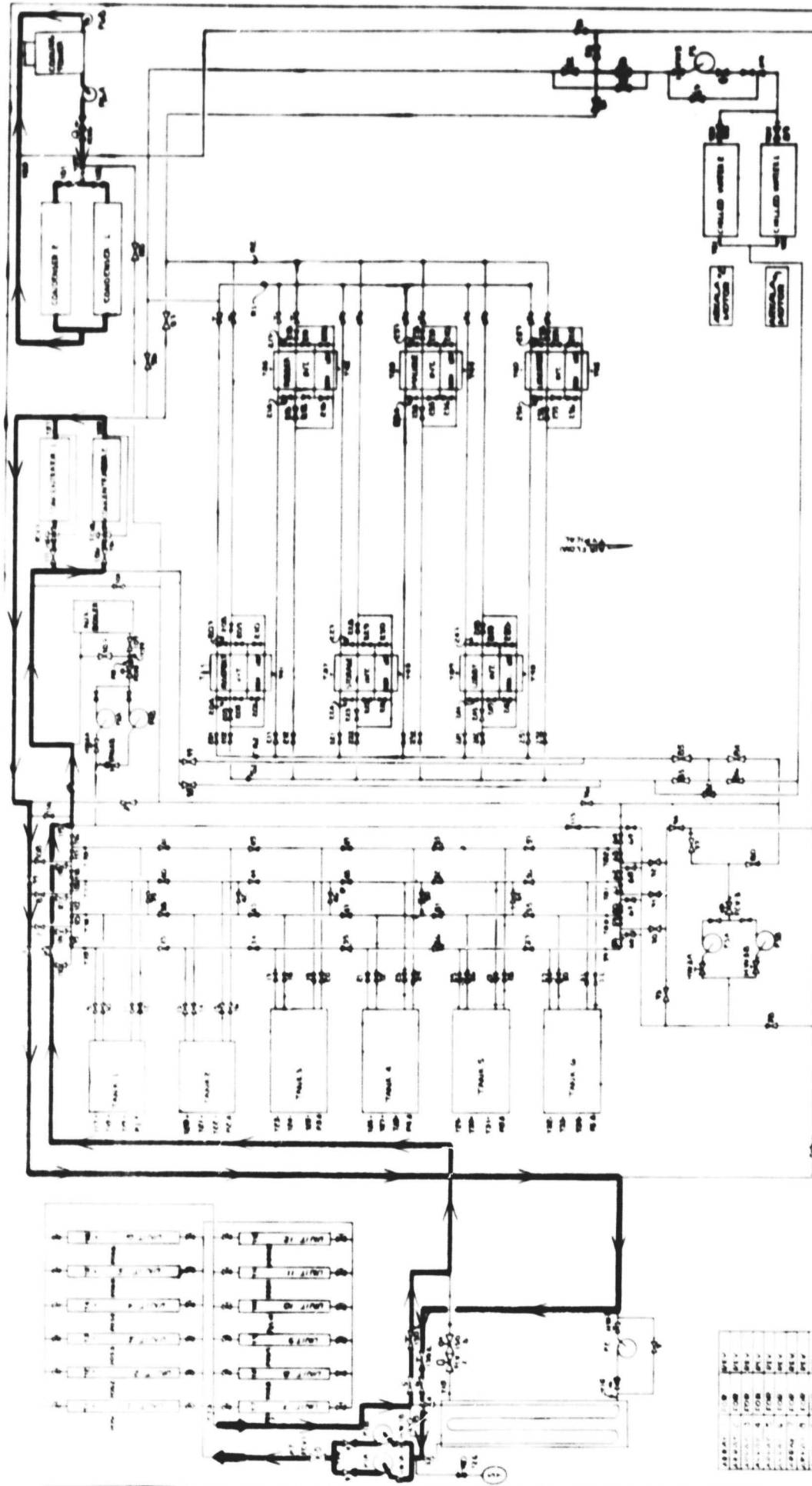




# AUXILLARY TO CHILLERS

FLOW DIA. PLATE # 8

| ITEM | DESCRIPTION      | QTY | UNIT |
|------|------------------|-----|------|
| 1    | PIPE 1/2" DIA    | 100 | FT   |
| 2    | PIPE 1/4" DIA    | 50  | FT   |
| 3    | PIPE 3/8" DIA    | 20  | FT   |
| 4    | PIPE 1/2" DIA    | 10  | FT   |
| 5    | PIPE 3/4" DIA    | 5   | FT   |
| 6    | PIPE 1" DIA      | 2   | FT   |
| 7    | PIPE 1 1/2" DIA  | 1   | FT   |
| 8    | PIPE 2" DIA      | 1   | FT   |
| 9    | PIPE 2 1/2" DIA  | 1   | FT   |
| 10   | PIPE 3" DIA      | 1   | FT   |
| 11   | PIPE 3 1/2" DIA  | 1   | FT   |
| 12   | PIPE 4" DIA      | 1   | FT   |
| 13   | PIPE 4 1/2" DIA  | 1   | FT   |
| 14   | PIPE 5" DIA      | 1   | FT   |
| 15   | PIPE 5 1/2" DIA  | 1   | FT   |
| 16   | PIPE 6" DIA      | 1   | FT   |
| 17   | PIPE 6 1/2" DIA  | 1   | FT   |
| 18   | PIPE 7" DIA      | 1   | FT   |
| 19   | PIPE 7 1/2" DIA  | 1   | FT   |
| 20   | PIPE 8" DIA      | 1   | FT   |
| 21   | PIPE 8 1/2" DIA  | 1   | FT   |
| 22   | PIPE 9" DIA      | 1   | FT   |
| 23   | PIPE 9 1/2" DIA  | 1   | FT   |
| 24   | PIPE 10" DIA     | 1   | FT   |
| 25   | PIPE 10 1/2" DIA | 1   | FT   |
| 26   | PIPE 11" DIA     | 1   | FT   |
| 27   | PIPE 11 1/2" DIA | 1   | FT   |
| 28   | PIPE 12" DIA     | 1   | FT   |
| 29   | PIPE 12 1/2" DIA | 1   | FT   |
| 30   | PIPE 13" DIA     | 1   | FT   |
| 31   | PIPE 13 1/2" DIA | 1   | FT   |
| 32   | PIPE 14" DIA     | 1   | FT   |
| 33   | PIPE 14 1/2" DIA | 1   | FT   |
| 34   | PIPE 15" DIA     | 1   | FT   |
| 35   | PIPE 15 1/2" DIA | 1   | FT   |
| 36   | PIPE 16" DIA     | 1   | FT   |
| 37   | PIPE 16 1/2" DIA | 1   | FT   |
| 38   | PIPE 17" DIA     | 1   | FT   |
| 39   | PIPE 17 1/2" DIA | 1   | FT   |
| 40   | PIPE 18" DIA     | 1   | FT   |
| 41   | PIPE 18 1/2" DIA | 1   | FT   |
| 42   | PIPE 19" DIA     | 1   | FT   |
| 43   | PIPE 19 1/2" DIA | 1   | FT   |
| 44   | PIPE 20" DIA     | 1   | FT   |
| 45   | PIPE 20 1/2" DIA | 1   | FT   |
| 46   | PIPE 21" DIA     | 1   | FT   |
| 47   | PIPE 21 1/2" DIA | 1   | FT   |
| 48   | PIPE 22" DIA     | 1   | FT   |
| 49   | PIPE 22 1/2" DIA | 1   | FT   |
| 50   | PIPE 23" DIA     | 1   | FT   |
| 51   | PIPE 23 1/2" DIA | 1   | FT   |
| 52   | PIPE 24" DIA     | 1   | FT   |
| 53   | PIPE 24 1/2" DIA | 1   | FT   |
| 54   | PIPE 25" DIA     | 1   | FT   |
| 55   | PIPE 25 1/2" DIA | 1   | FT   |
| 56   | PIPE 26" DIA     | 1   | FT   |
| 57   | PIPE 26 1/2" DIA | 1   | FT   |
| 58   | PIPE 27" DIA     | 1   | FT   |
| 59   | PIPE 27 1/2" DIA | 1   | FT   |
| 60   | PIPE 28" DIA     | 1   | FT   |
| 61   | PIPE 28 1/2" DIA | 1   | FT   |
| 62   | PIPE 29" DIA     | 1   | FT   |
| 63   | PIPE 29 1/2" DIA | 1   | FT   |
| 64   | PIPE 30" DIA     | 1   | FT   |
| 65   | PIPE 30 1/2" DIA | 1   | FT   |
| 66   | PIPE 31" DIA     | 1   | FT   |
| 67   | PIPE 31 1/2" DIA | 1   | FT   |
| 68   | PIPE 32" DIA     | 1   | FT   |
| 69   | PIPE 32 1/2" DIA | 1   | FT   |
| 70   | PIPE 33" DIA     | 1   | FT   |
| 71   | PIPE 33 1/2" DIA | 1   | FT   |
| 72   | PIPE 34" DIA     | 1   | FT   |
| 73   | PIPE 34 1/2" DIA | 1   | FT   |
| 74   | PIPE 35" DIA     | 1   | FT   |
| 75   | PIPE 35 1/2" DIA | 1   | FT   |
| 76   | PIPE 36" DIA     | 1   | FT   |
| 77   | PIPE 36 1/2" DIA | 1   | FT   |
| 78   | PIPE 37" DIA     | 1   | FT   |
| 79   | PIPE 37 1/2" DIA | 1   | FT   |
| 80   | PIPE 38" DIA     | 1   | FT   |
| 81   | PIPE 38 1/2" DIA | 1   | FT   |
| 82   | PIPE 39" DIA     | 1   | FT   |
| 83   | PIPE 39 1/2" DIA | 1   | FT   |
| 84   | PIPE 40" DIA     | 1   | FT   |
| 85   | PIPE 40 1/2" DIA | 1   | FT   |
| 86   | PIPE 41" DIA     | 1   | FT   |
| 87   | PIPE 41 1/2" DIA | 1   | FT   |
| 88   | PIPE 42" DIA     | 1   | FT   |
| 89   | PIPE 42 1/2" DIA | 1   | FT   |
| 90   | PIPE 43" DIA     | 1   | FT   |
| 91   | PIPE 43 1/2" DIA | 1   | FT   |
| 92   | PIPE 44" DIA     | 1   | FT   |
| 93   | PIPE 44 1/2" DIA | 1   | FT   |
| 94   | PIPE 45" DIA     | 1   | FT   |
| 95   | PIPE 45 1/2" DIA | 1   | FT   |
| 96   | PIPE 46" DIA     | 1   | FT   |
| 97   | PIPE 46 1/2" DIA | 1   | FT   |
| 98   | PIPE 47" DIA     | 1   | FT   |
| 99   | PIPE 47 1/2" DIA | 1   | FT   |
| 100  | PIPE 48" DIA     | 1   | FT   |



# SOLAR COLLECTION TO CHILLERS

FLOW DIA. PLATE 9

| DATE   | TIME  | TEMP. | PRESS.  | FLOW   | STATUS |
|--------|-------|-------|---------|--------|--------|
| 1/1/78 | 10:00 | 120°F | 150 PSI | 10 GPM | OK     |
| 1/1/78 | 11:00 | 125°F | 155 PSI | 10 GPM | OK     |
| 1/1/78 | 12:00 | 130°F | 160 PSI | 10 GPM | OK     |
| 1/1/78 | 13:00 | 135°F | 165 PSI | 10 GPM | OK     |
| 1/1/78 | 14:00 | 140°F | 170 PSI | 10 GPM | OK     |
| 1/1/78 | 15:00 | 145°F | 175 PSI | 10 GPM | OK     |
| 1/1/78 | 16:00 | 150°F | 180 PSI | 10 GPM | OK     |
| 1/1/78 | 17:00 | 155°F | 185 PSI | 10 GPM | OK     |
| 1/1/78 | 18:00 | 160°F | 190 PSI | 10 GPM | OK     |
| 1/1/78 | 19:00 | 165°F | 195 PSI | 10 GPM | OK     |
| 1/1/78 | 20:00 | 170°F | 200 PSI | 10 GPM | OK     |
| 1/1/78 | 21:00 | 175°F | 205 PSI | 10 GPM | OK     |
| 1/1/78 | 22:00 | 180°F | 210 PSI | 10 GPM | OK     |
| 1/1/78 | 23:00 | 185°F | 215 PSI | 10 GPM | OK     |
| 1/1/78 | 24:00 | 190°F | 220 PSI | 10 GPM | OK     |

### List of AS BUILT Drawings

|  |               |            |
|--|---------------|------------|
| Plant Site Plot Plan                     | 75-230 1      | Plate # 1  |
| Plant Site Topo & Drainage Plan          | 75-230 1-A    | Plate # 2  |
| Plant Floor Plan                         | 75-230 2      | Plate # 3  |
| Plant Elevation                          | 75-230 3      | Plate # 4  |
| Plant Foundation Plan                    | 75-230 4      | Plate # 5  |
| Plant Roof Framing Plan                  | 75-230 5      | Plate # 6  |
| Plant Office Area Layout                 | 75-230 6      | Plate # 7  |
| Plant Sections                           | 75-230 7      | Plate # 8  |
| Solar Storage Tank Assembly              | DN-10010      | Plate # 9  |
| Solar Storage Tank (10,000 Gal.)         | D-10006       | Plate # 10 |
| Solar Storage Tank (5,000 Ga.)           | C-10005       | Plate # 11 |
| Solar Typ. Pump Arrangement              | DN-100097     | Plate # 12 |
| Solar Typ. "SG" on/off Valve Arrangement | BN-10026      | Plate # 13 |
| Solar Array Section                      | L-A-HW-AC-140 | Plate # 14 |
| Solar Sub-Array Assembly                 | S-H-03-15-7   | Plate # 15 |
| Solar Mech. Room Isometric               | E 51002 E     | Plate # 16 |
| Solar Mech. Room Top View                | EN 10000 c    | Plate # 17 |
| Solar Mech. Room (Section A-A)           | EN 10011 C    | Plate # 18 |
| Solar Mech. Room (section C-C)           | DN-10003-B    | Plate # 19 |
| Solar Mech. Room (Section B-B)           | EN-10006-C    | Plate # 20 |
| Solar Mech. Room (Section D-D)           | CN-10013-B    | Plate # 21 |
| Solar Mech. Room (Section E-E)           | CN-10009-A    | Plate # 22 |
| Solar Mech. Room (Section F-F)           | CN-10008-B    | Plate # 23 |
| Solar Mech. Room (Section G-G)           | DN-10007-A    | Plate # 24 |
| Solar Mech. Room (Section H-H)           | DN-10004-A    | Plate # 25 |
| Solar Mech. Room (Section J-J)           | CN-10002      | Plate # 26 |
| Plant Electrical Service Plan            | DN-100099     | Plate # 27 |
| Plant Electrical Service Entrance Plan   | DN-100098     | Plate # 28 |

List of AS BUILT Drawings (cont'd).

|   |          |           |
|---|----------|-----------|
| Plant Electrical Layout Plan                  | E-1      | Plate #29 |
| Plant & Berm Electrical Layout Plan           | E-2      | Plate #30 |
| Solar Plant Piping & AHV Plan                 | EN-10012 | Plate #31 |
| Solar Collection Piping Loop Plan             | EN-10005 | Plate #32 |
| Solar Loop Pre Heating Computer Floor<br>Dia. | DN-10032 | Plate #33 |
| H <sub>2</sub> O-Tanks To Air Handlers        | DN-10033 | Plate #34 |
| Solar Computer Block Dia.                     | BN-10034 | Plate #35 |
| Solar Computer Input/Output Table             | DN-10045 | Plate #36 |
| Piping Schematic                              | DN-10016 | Plate #37 |

BLOCK 88, LOT 13  
H/1 L.E. JAMES

N 75° 07' 51" E 187.48



BLOCK 88, LOT 4  
H/1 L.E. JAMES  
1/2 L. JAMES



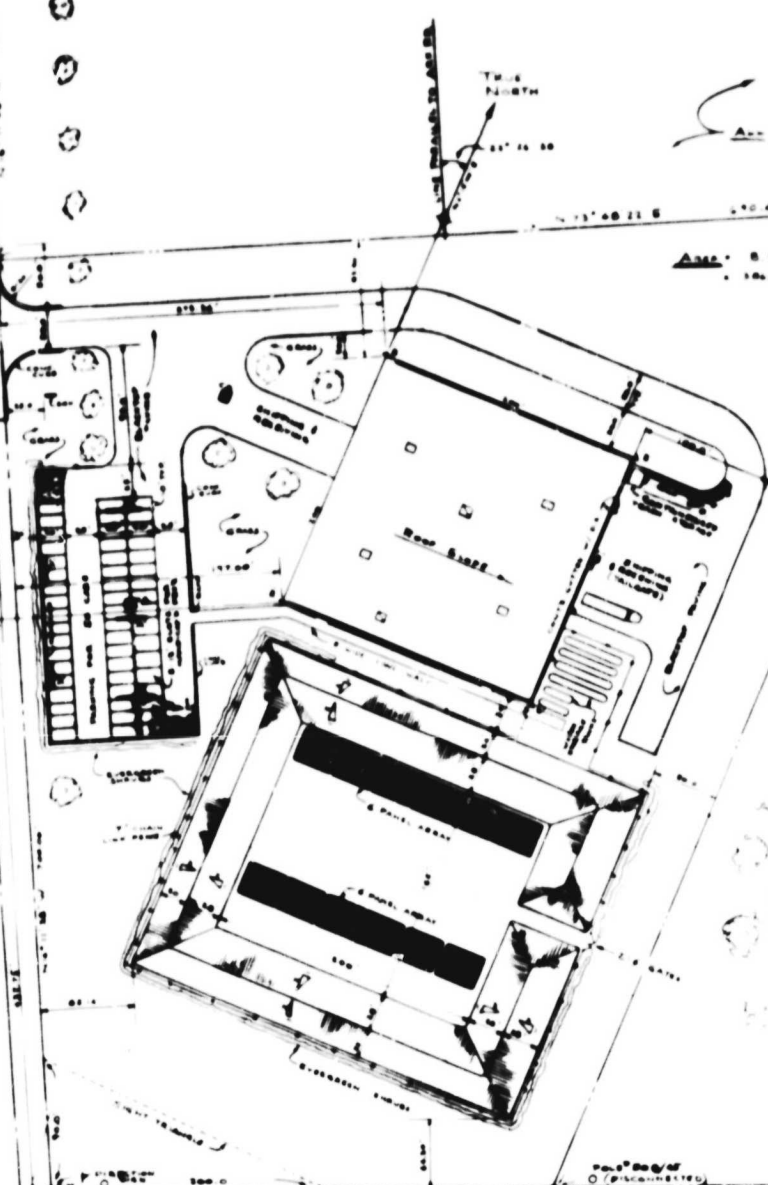
ENTRANCE CURB DETAIL  
SCALE 1/4" = 1'-0"



PARKING LOT CURB DETAIL  
SCALE 1/4" = 1'-0"

BLOCK 88, LOT 6  
H/1 C. P. THALMANN  
H/1 L. JAMES

ARK ROAD (49.5' WIDE)



COOLING POND  
1/2 ACRES

STACY HAINES ROAD (49.5' WIDE)

BLOCK 88, LOT 1  
H/1 A.A. G. CARLINO

BLOCK 87, LOT 9  
H/1 D.C. RIVINGTON

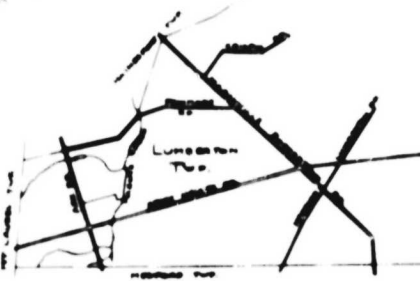
H/1 D.C. RIVINGTON  
100' 0" 0.00

H/1 D.C. RIVINGTON  
100' 0" 0.00

H/1 D.C. RIVINGTON  
100' 0" 0.00

H/1 D.C. RIVINGTON  
100' 0" 0.00

ORIGINAL PAGE IS  
OF POOR QUALITY



KEY PLAN

PLOT PLAN

SCALE 1" = 50'



LETTERING BOTH SIDES



Sign  
DETAIL

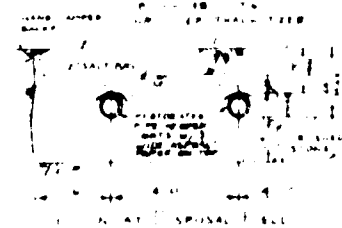
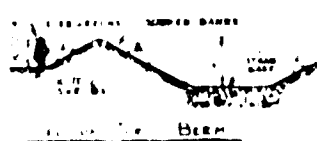
FOLDOUT FRAME



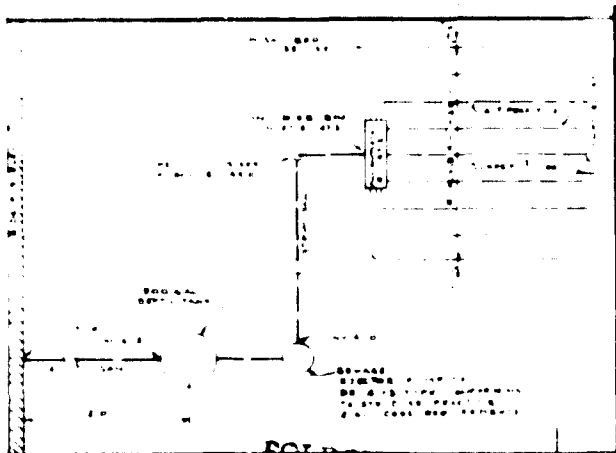


BLOCK 19, LOT 4  
N. JONES ST. & J. JONES ST.

NEW  
SEED  
AREA



BLOCK 17, LOT 4  
N. JONES ST. & J. JONES ST.



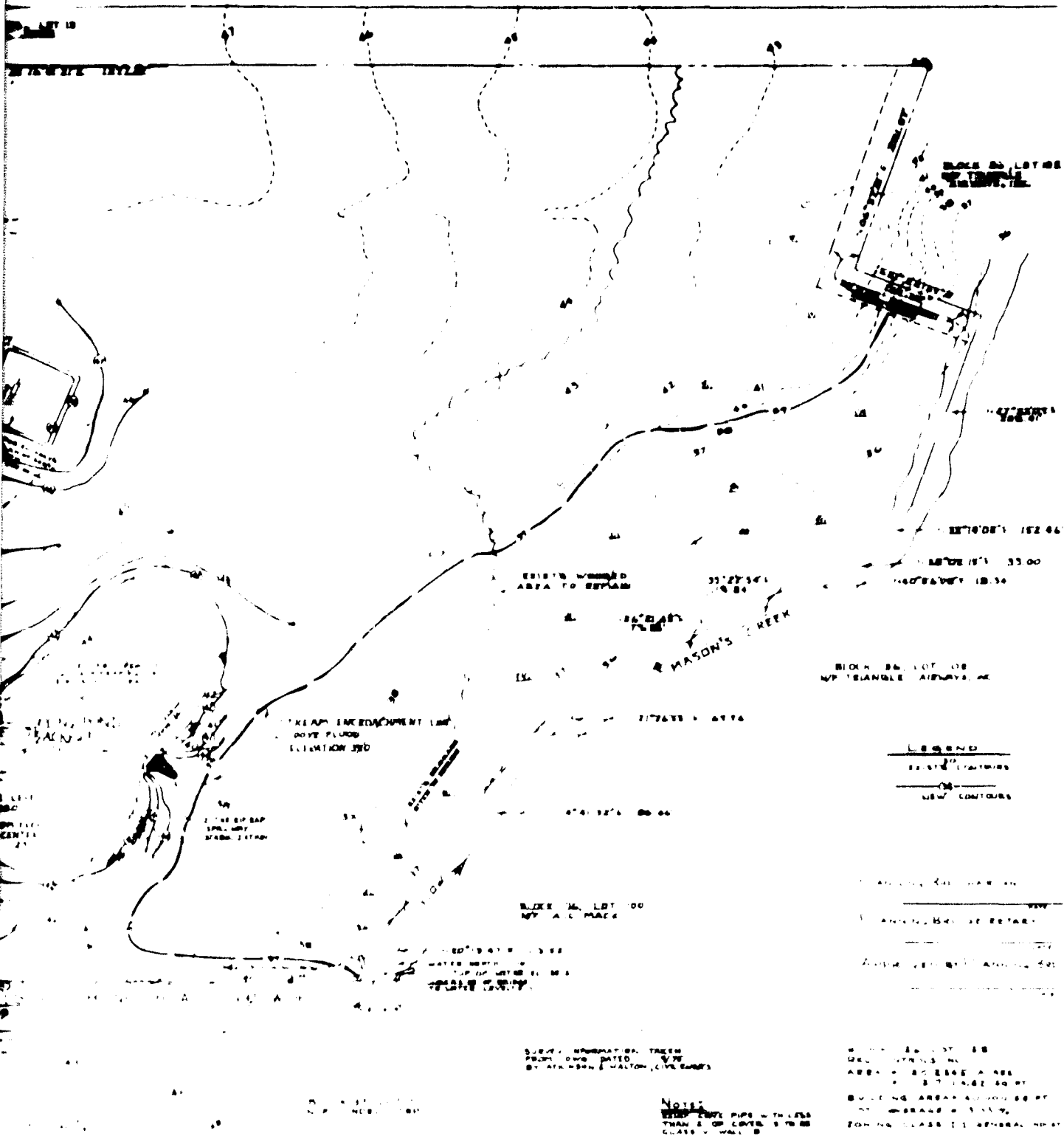
FOLDOUT FRAME

SECTION LINE  
OF DAM

SECTION LINE  
OF DAM

SECTION AT POND INLET

WATER LEVEL EL. 500.0  
WATER LEVEL EL. 500.0



# LEGEND

- EXISTING CONTOURS
- NEW CONTOURS

PLANNING BOARD SECRETARY  
 PLANNING BOARD SECRETARY  
 PLANNING BOARD SECRETARY

NOTICE  
 A CORRECTION HAS BEEN MADE  
 TO THE PLANNING BOARD SECRETARY  
 PLANNING BOARD SECRETARY

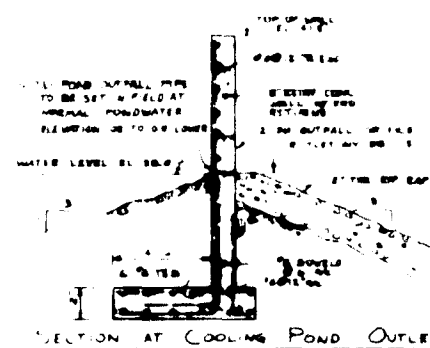
NOTICE  
 A CORRECTION HAS BEEN MADE  
 TO THE PLANNING BOARD SECRETARY  
 PLANNING BOARD SECRETARY

NOTICE  
 A CORRECTION HAS BEEN MADE  
 TO THE PLANNING BOARD SECRETARY  
 PLANNING BOARD SECRETARY

NOTICE  
 A CORRECTION HAS BEEN MADE  
 TO THE PLANNING BOARD SECRETARY  
 PLANNING BOARD SECRETARY

NOTICE  
 A CORRECTION HAS BEEN MADE  
 TO THE PLANNING BOARD SECRETARY  
 PLANNING BOARD SECRETARY

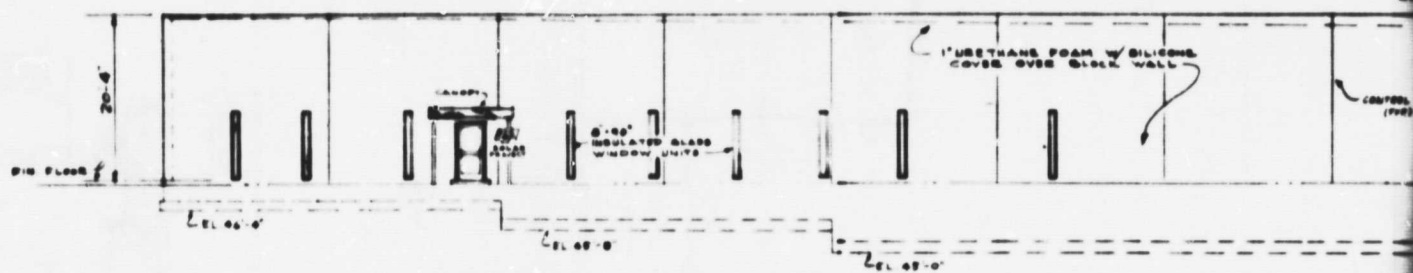
NOTICE  
 A CORRECTION HAS BEEN MADE  
 TO THE PLANNING BOARD SECRETARY  
 PLANNING BOARD SECRETARY



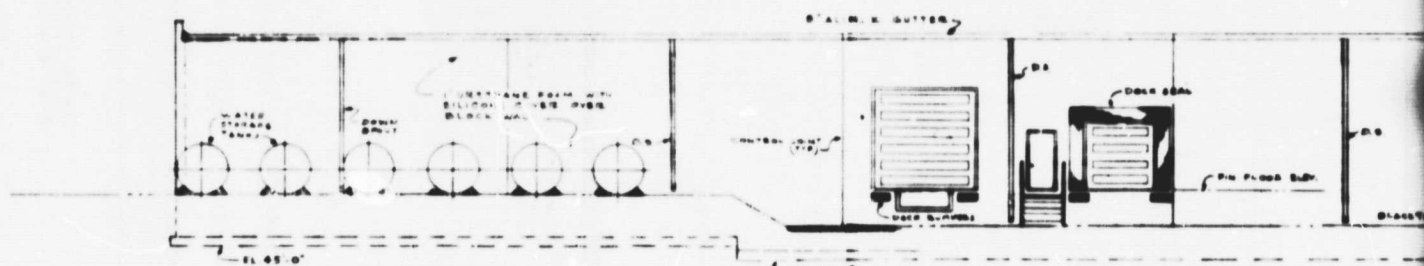




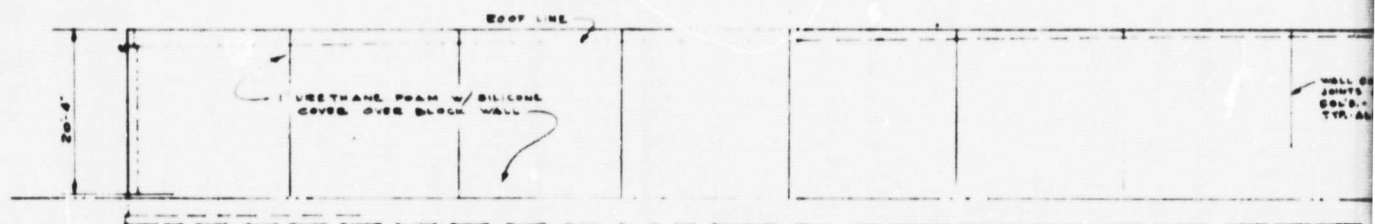




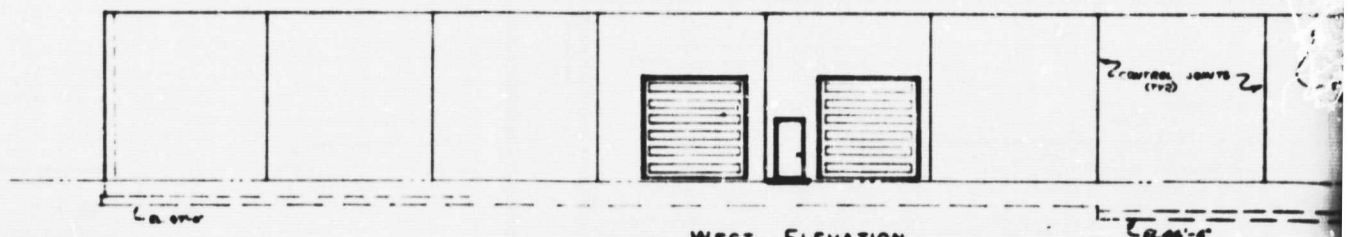
SOUTH ELEVATION- FRONT



EAST ELEVATION



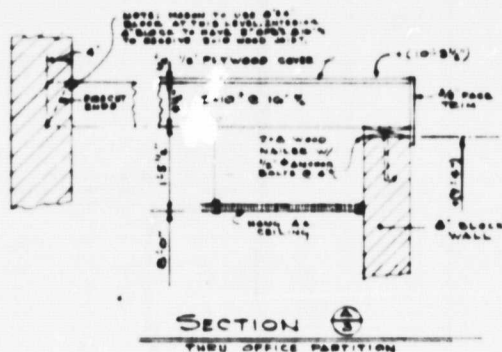
NORTH ELEVATION



WEST ELEVATION

FOLDOUT FRAME





NOTE: CLOSET HEIGHT = 8'-0" UNLESS NOTED

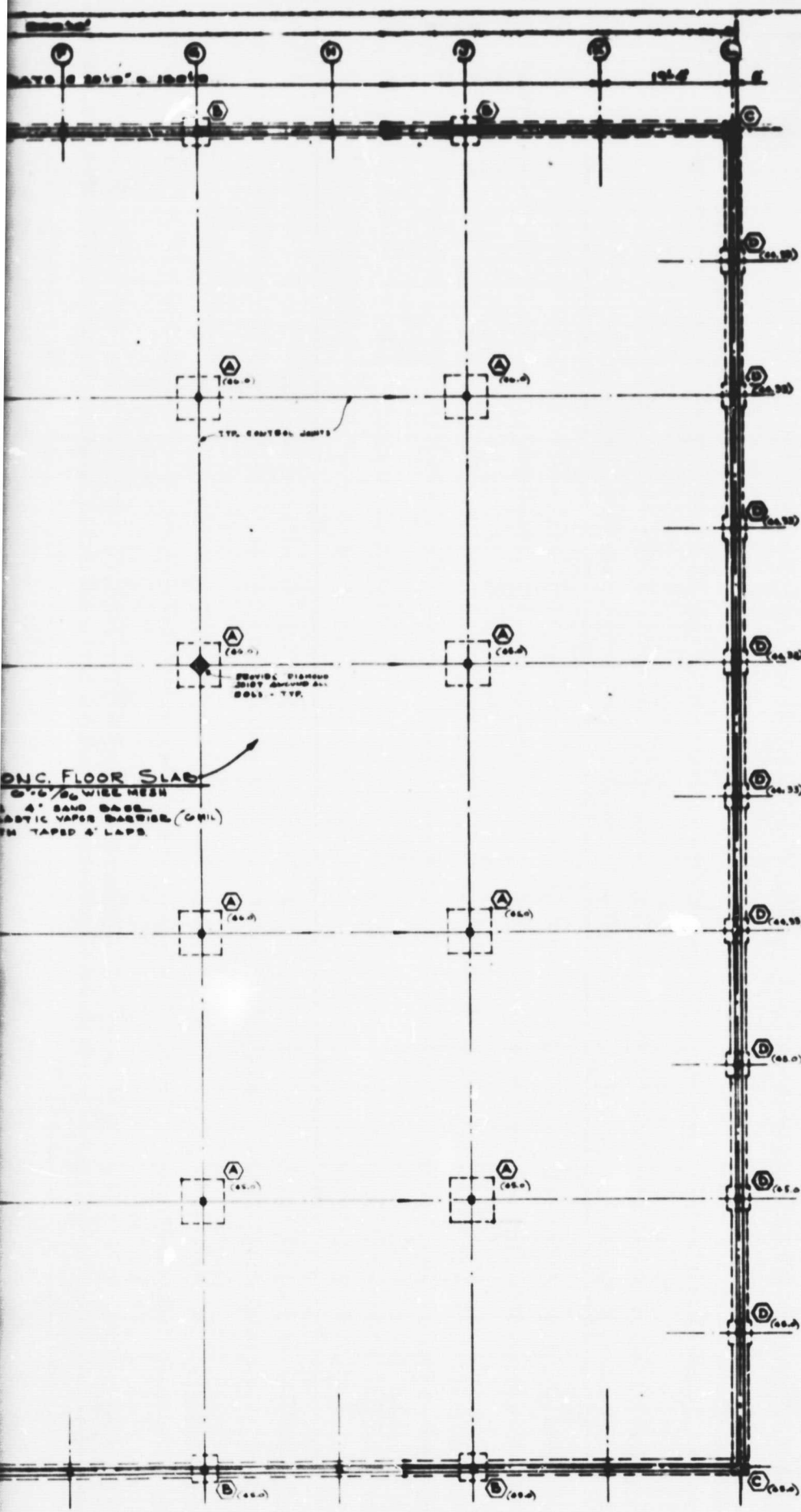
## FOLDOUT FRAME

PROPOSED BUILDING FOR  
**RKL CONTROLS**  
LIMESTON TWP. N. J.  
**PAUL ENGINEERING**  
ONE N. LINDS ROAD AV  
CHERRY HILL, N. J. 08004

DAYS 7-10 TO  
DATE  
3  
75-234





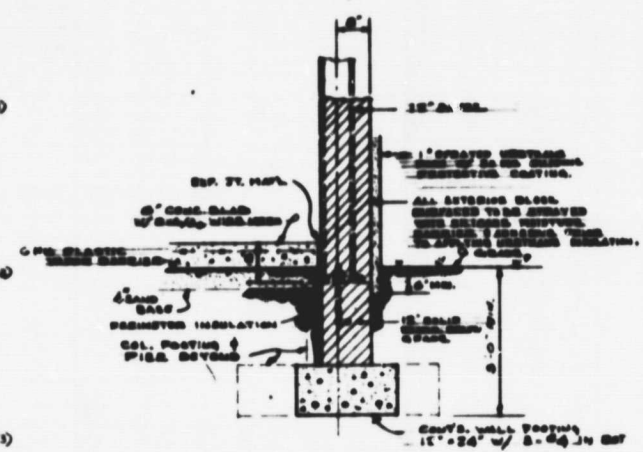


### FOOTING SCHEDULE

ALLOWED BEARING = 2000 PSF

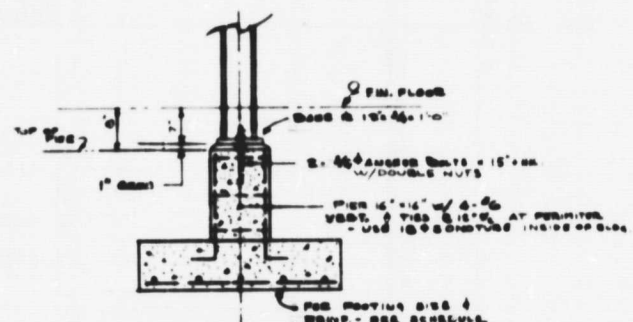
- Ⓐ 6" x 6" SQ. x 12" THK. REINER = 7" x 5" W.
  - Ⓑ 4" x 6" SQ. x 12" THK. REINER = 5" x 5" W.
  - Ⓒ 2" x 6" SQ. x 12" THK. REINER = 4" x 4" W.
  - Ⓓ 3" x 6" SQ. x 12" THK. REINER = 4" x 4" W.
- SPACING OF FOOTINGS = 12' O.C. UNLESS SHOWN AS (P)

ALL CONC. TO BE 4000 PSI. 28 DAYS.  
 CONC. PLACED TO BE CURED WITH LIGHT MOISTURE.  
 ALL FOOTINGS TO BE ON UNFROZEN SOIL.  
 ALL CONC. WORK TO BE IN ACCORDANCE WITH CURRENT  
 S.E.C. CODES.



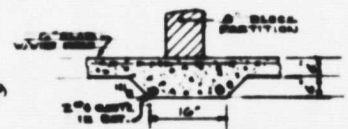
TYPICAL SECTION

SCALE 3/4" = 1'-0"



TYPICAL FOOTING DETAIL

SCALE 3/4" = 1'-0"



TYP. SLAB DETAIL  
AT BLOCK PARTITIONS

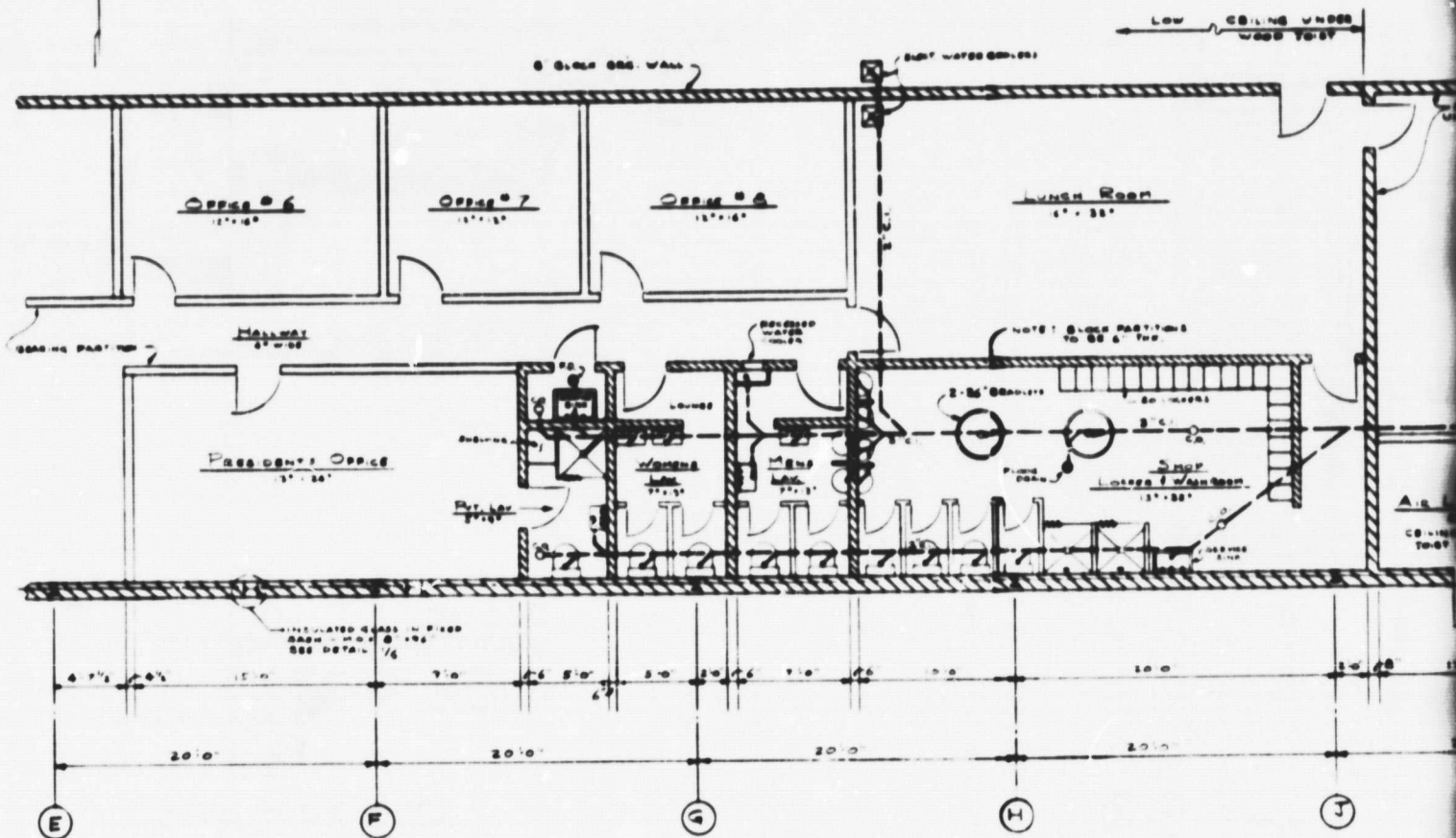
|                       |                 |
|-----------------------|-----------------|
| PROPOSED BUILDING FOR |                 |
| RKL CONTROLS          |                 |
| LUNESTON TWP. ME      |                 |
| PAUL ENGINEERING      |                 |
| ON A 2000 HOURS       |                 |
| CONTRACT NO. 1234     |                 |
| DATE<br>3/15/77       | FOUNDATION PLAN |
| SCALE<br>1/4" = 1'-0" | 4               |







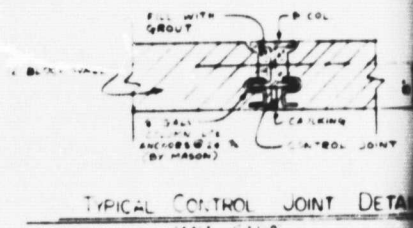
PROJECT NORTH

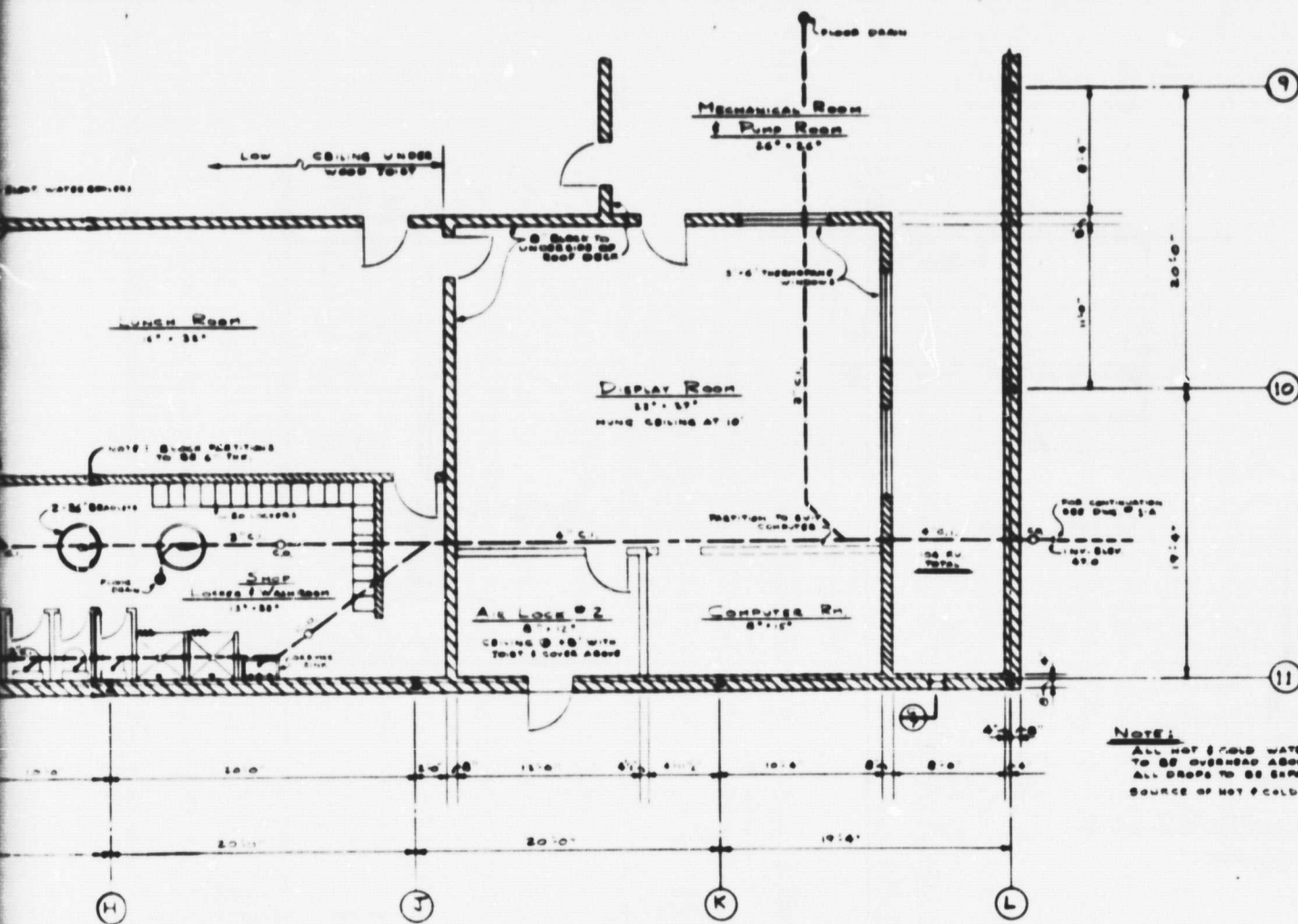


PARTIAL OFFICE AREA LAYOUT

SCALE 1/8" = 1'-0"

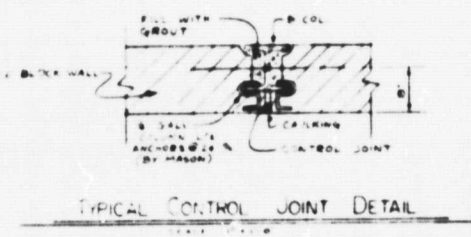
FOLDOUT FRAME





**NOTE:**  
ALL HOT & COLD WATER SUPPLY PIPING  
TO BE OVERHEAD ABOVE HUNG CEILING.  
ALL DROPS TO BE EXPOSED, WALL FASTENED.  
SOURCE OF HOT & COLD WATER SUPPLY BY OWNER.

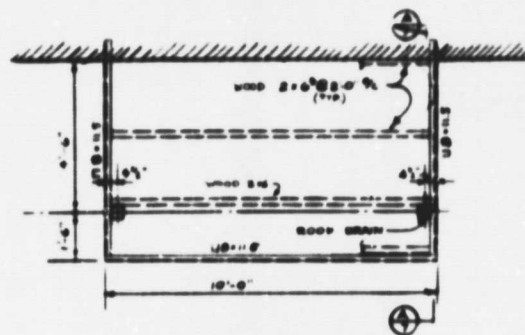
**OFFICE AREA LAYOUT**  
SCALE 1/8" = 1'-0"



**TYPICAL CONTROL JOINT DETAIL**  
SCALE 1/4" = 1'-0"

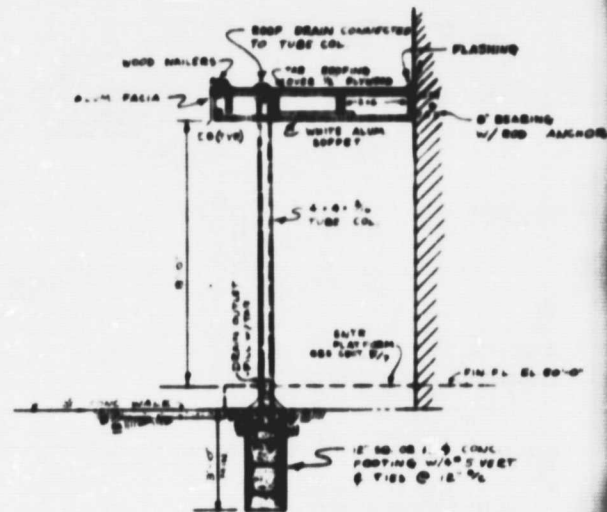
## FOLDOUT FRAME 2

|  |                       |                                |
|--|-----------------------|--------------------------------|
| PROPOSED BUILDING FOR<br><b>RKL CONTROLS</b><br>LUMBERTON, N.J.      |                       |                                |
| <b>PAUL ENGINEERING</b><br>40 R. 1000 RD.<br>CHERRY HILL, N.J. 08001 |                       |                                |
| DATE<br>8-10-77<br>BY<br>P.E.  | OFFICE AREA<br>LAYOUT | DWG. NO.<br><b>6</b><br>77-200 |



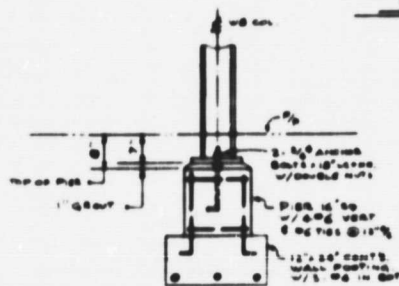
ENTRANCE CANOPY - PLAN

SCALE 1/8" = 1'-0"



ENTRANCE CANOPY - SECTION

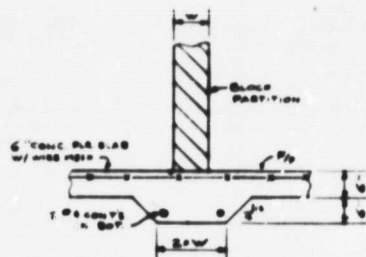
SCALE 1/8" = 1'-0"



TYP. PIER DETAIL AT INTERMEDIATE COL.

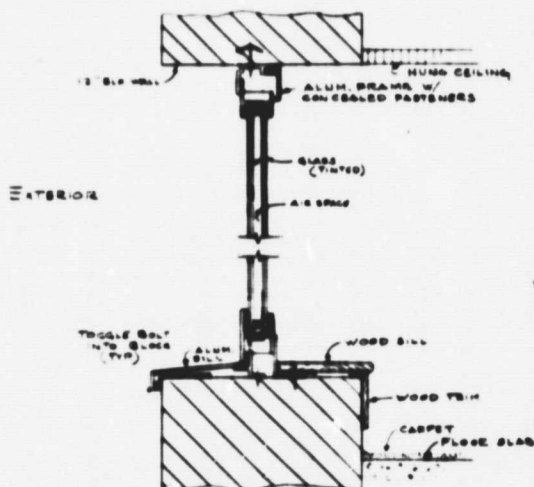
LINE 1 & 11

SCALE 1/8" = 1'-0"



TYP. SLAB DET. AT BLF. PARTITION

SCALE 1/8" = 1'-0"

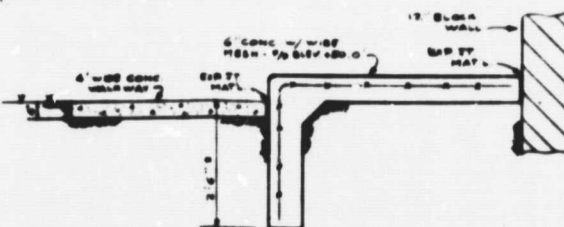


SECTION 9 TYPICAL INSULATED

GLASS WINDOW DETAIL

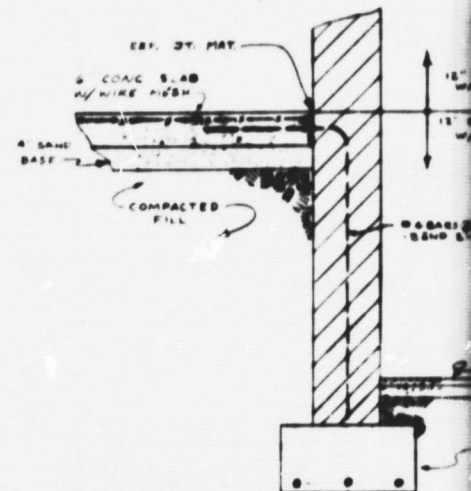
SCALE 1/8" = 1'-0"

FOLDOUT FRAME



SECTION 10 THRU ENTR. STEP

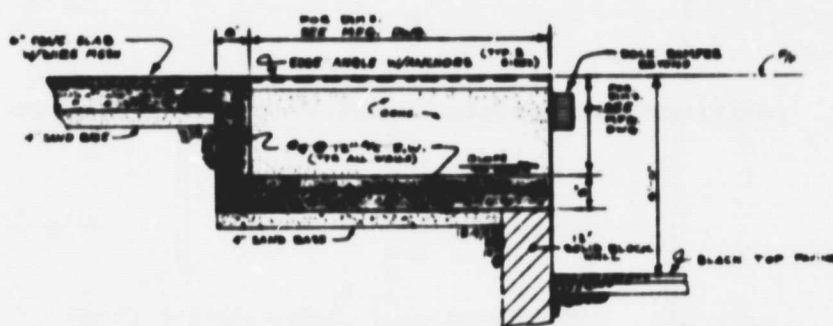
SCALE 1/8" = 1'-0"



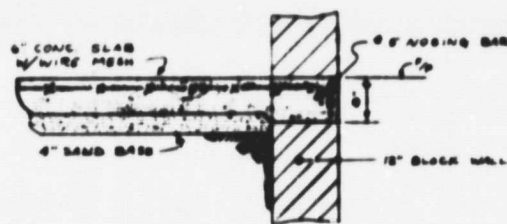
WALL SECTION 11 TYPICAL

COL. LINE L BETWEEN

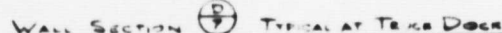
SCALE 1/8" = 1'-0"



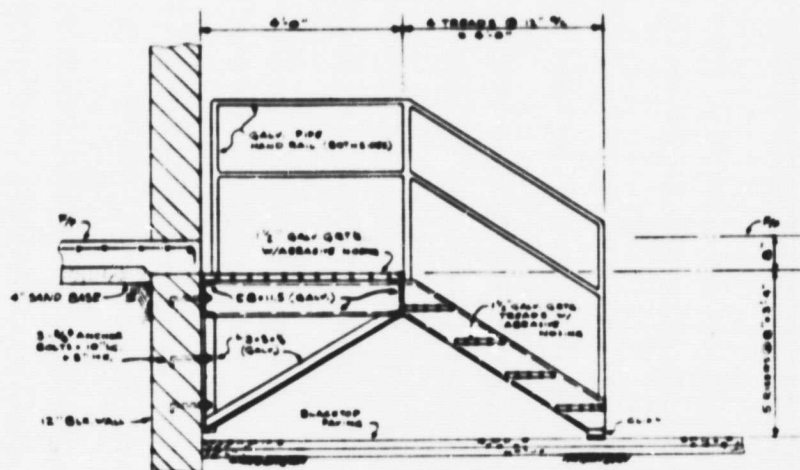
SECT.  THRU DOCK LEVELER



TYP Q.H DOOR SILL SECTION 



Col. Line "L" Between Line "2" & "9"

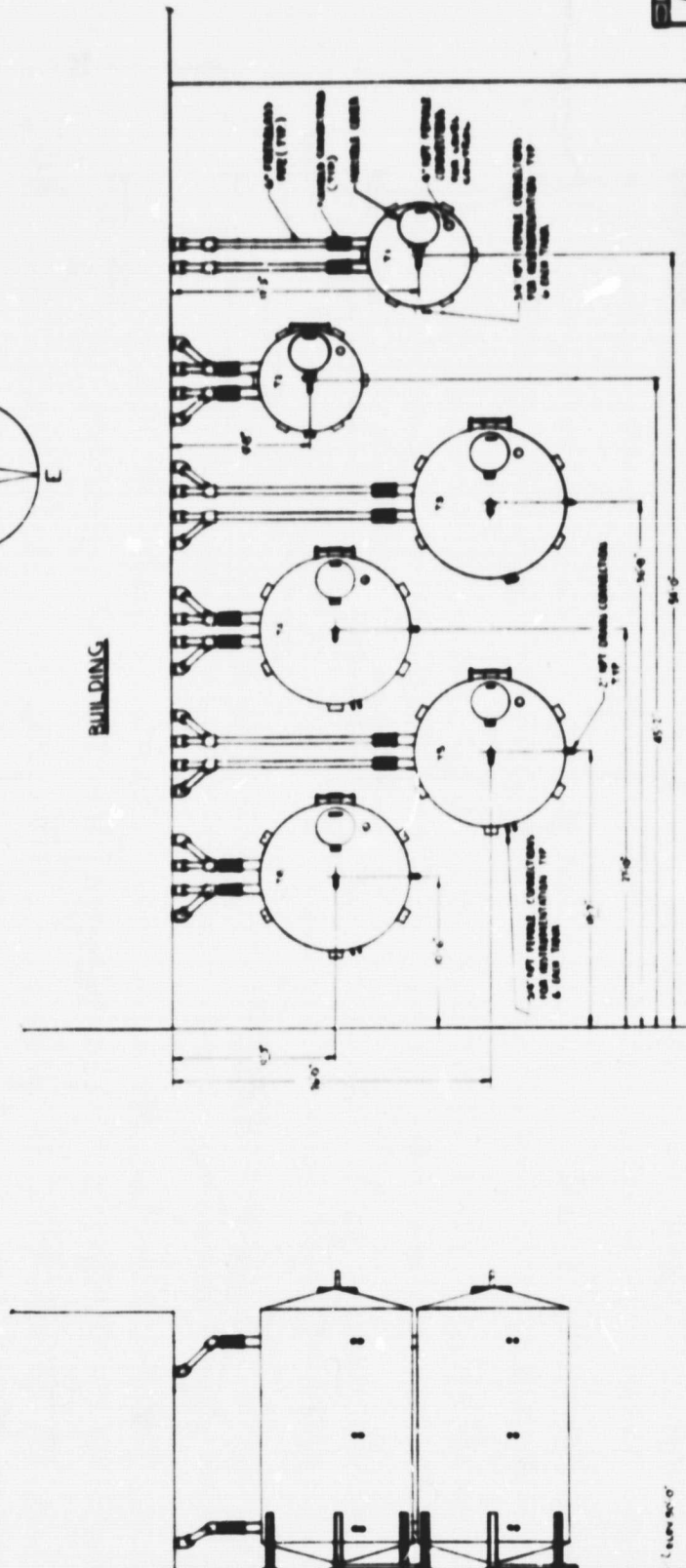


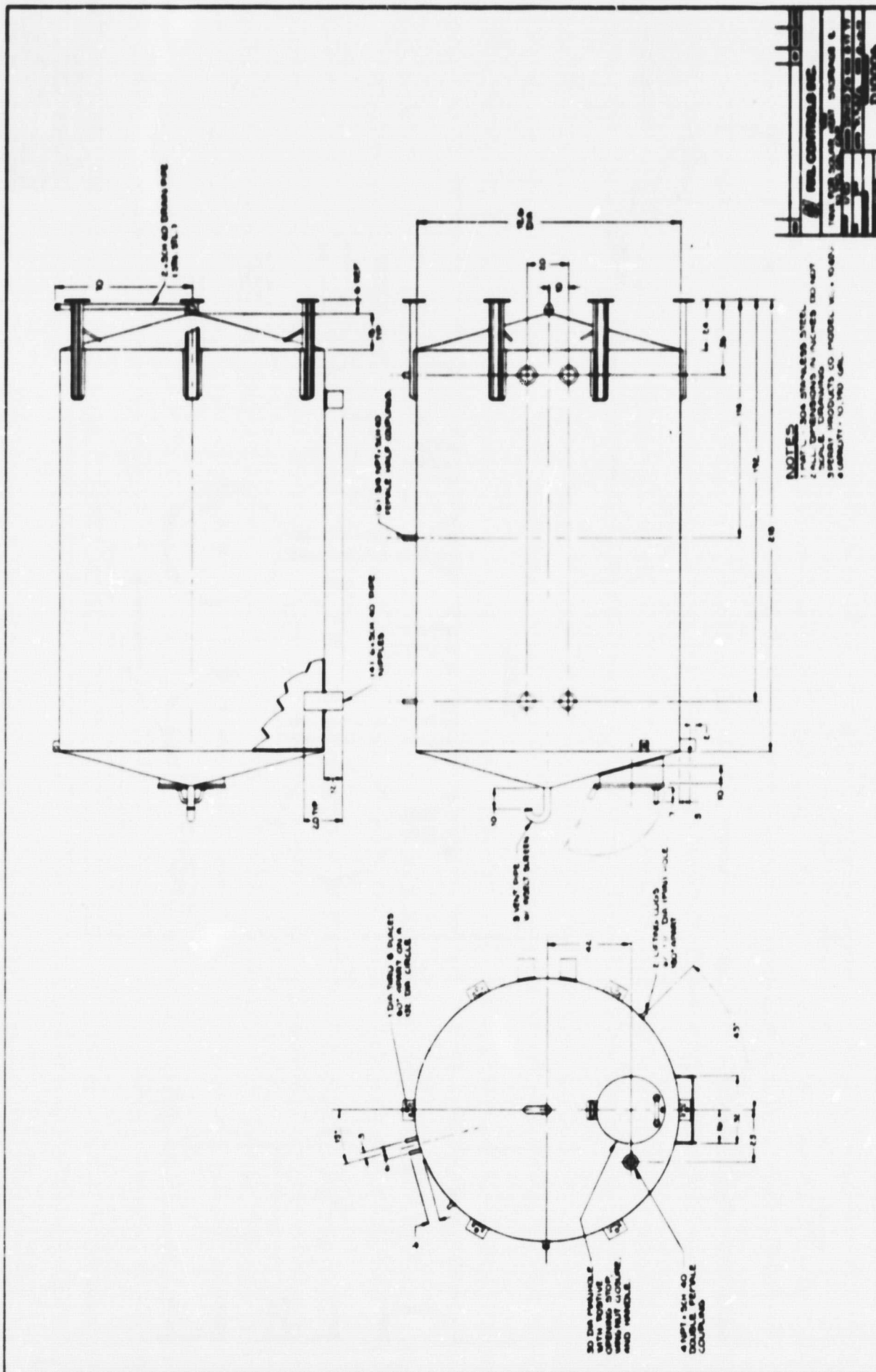
SECTION  THRU. METAL STAIRS (TYPICAL)

FOI.DONT FRAME 2

PROPOSED BUILDING FOR  
RKL CONTROLS  
LIMESTON TWP NJ  
PAULL ENGINEERING  
ONE N. LINDS HIGHWAY  
CHERRY HILL, N. J. 08034  
DATE 10-26-77  
SCALE As shown  
SUN ENG  
SECTIONS  
Dwg No 7  
PAGE 1



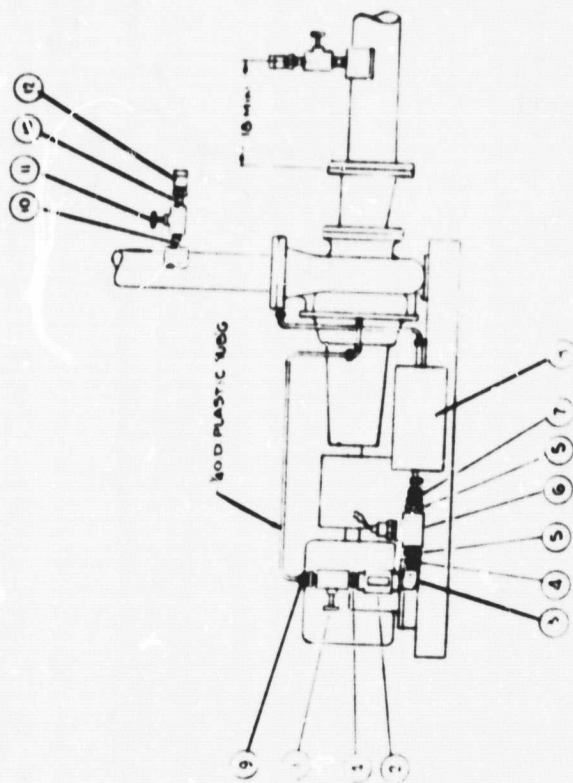








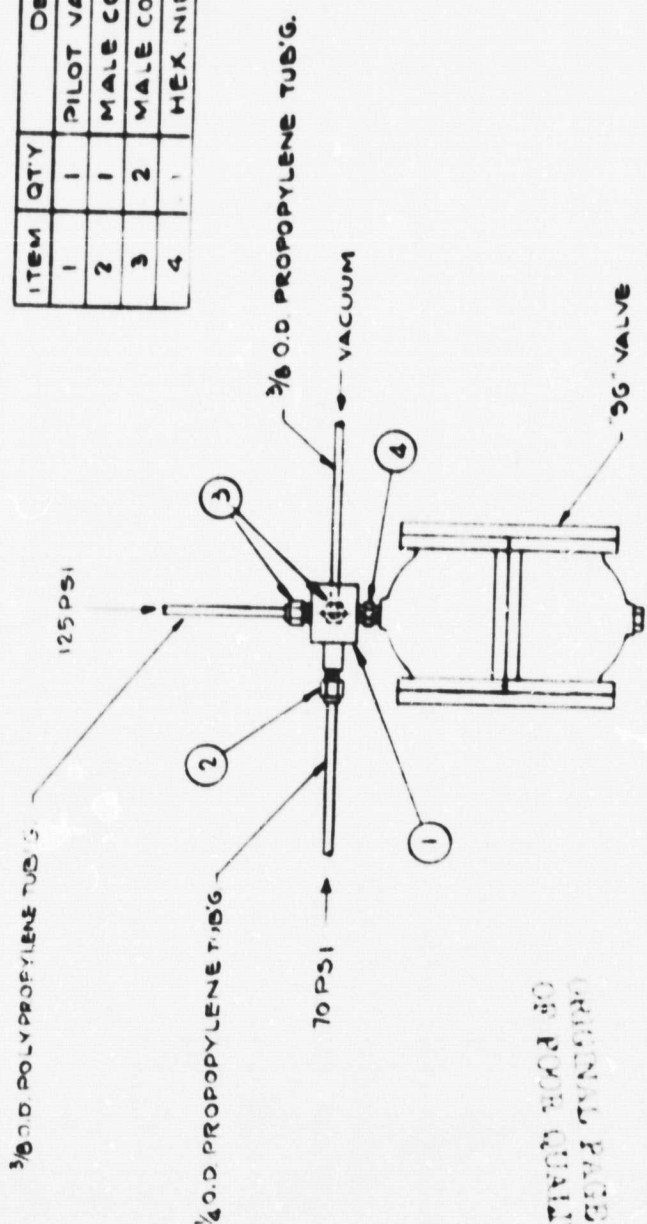
NOTE:  
QTY'S SHOWN ARE FOR ONE PUMP



| ITEM | QTY | DESCRIPTION                                 |
|------|-----|---|
| 1    | 1   | BAR STOCK SHUT-OFF VALVE 1/2" NPT           |
| 2    | 1   | BRIST RATE F. 0.000404 1/2" NPT 1-60PM      |
| 3    | 1   | 1/2" STREET EL                              |
| 4    | 2   | 1/2" NPT E                                  |
| 5    | 2   | RED PUSHING 1 NPT 1/2" NPT                  |
| 6    | 1   | BRIST MAGNETIC PRESSURE FLOW SW-10 3-50PM   |
| 7    | 1   | SWAGELOC MALE CONN. 9000-1-0                |
| 8    | 1   | PM TYPE CORNER                              |
| 9    | 1   | SWAGE 1/2" MALE LOWN 9000-1-0               |
| 10   | 2   | 1/2" NPT E                                  |
| 11   | 2   | 1/2" BAR STOCK SHUT-OFF VALVE               |
| 12   | 2   | SCOVILL QUICK DISCONNECT 9000-128 MATING PT |

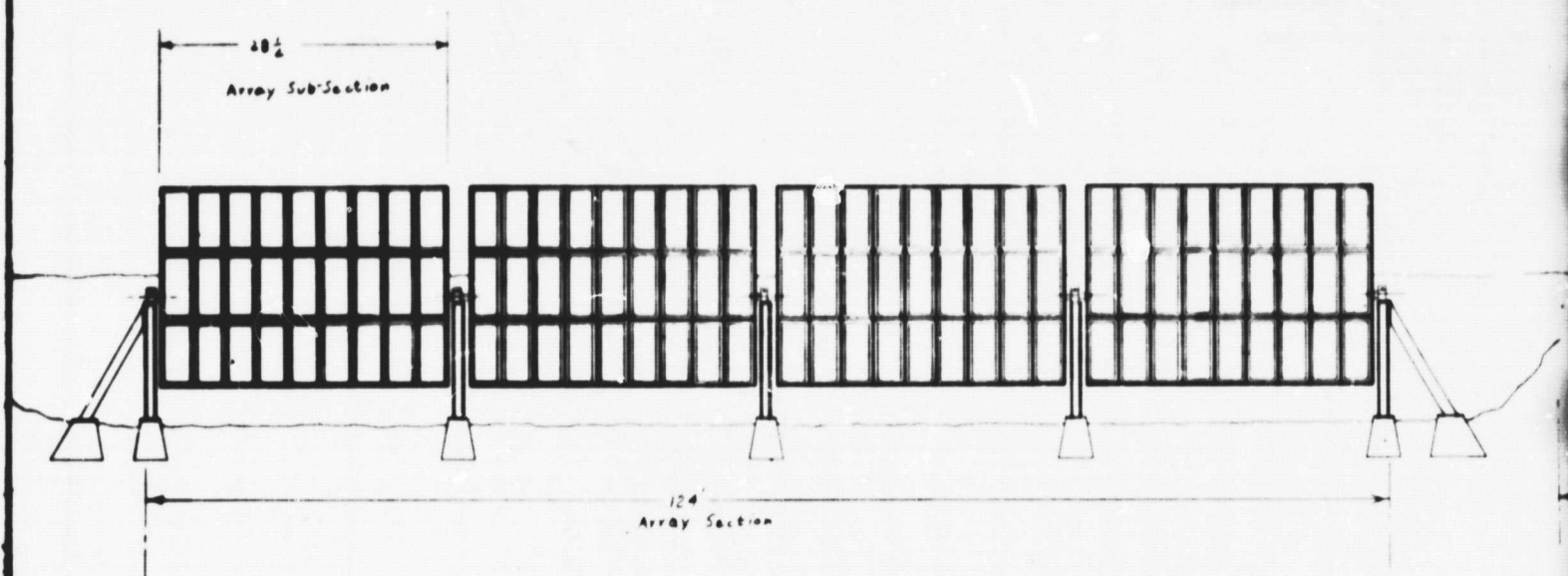
|                                 |           |
|---------------------------------|-----------|
| RKL CONTROLS INC.               |           |
| MECH ROOM TYP PUMP INST IN ARCT |           |
| DATE                            | 10-10-67  |
| BY                              | UN-100097 |

| ITEM | QTY | DESCRIPTION                | MANUF          |
|------|-----|----------------------------|----------------|
| 1    | 1   | PILOT VALVE #250A-3-10-20  | HUMPHREY PROD. |
| 2    | 1   | MALE CONNECTOR #3115-60-11 | LEGRI'S        |
| 3    | 2   | MALE CONNECTOR #3115-60-14 | LEGRI'S        |
| 4    | 1   | HEX NIPPLE 1/4 MPT #4HN    | CAJON          |



ORIGINAL PAGE IS  
OF POOR QUALITY

|  |      |        |    |      |          |
|--|------|--------|----|------|----------|
| TOLERANCES<br>UNLESS OTHERWISE SPECIFIED   | FEET | INCHES | OF | DATE | APPROVED |
| DECIMAL  |      |        |    |      |          |
| FRACTIONAL   |      |        |    |      |          |
| ANGULAR  |      |        |    |      |          |
| <b>RKL CONTROLS INC.</b><br>MECH ROOM TYP. 5G VALVE ARR'G'T.<br>SCALE: 1" = 1' 0"<br>DRAWN BY: [blank] DATE: [blank]<br>CHECKED BY: [blank] DATE: [blank]<br>APPROVED BY: [blank] DATE: [blank]<br>NOVA BN 10026 |      |        |    |      |          |

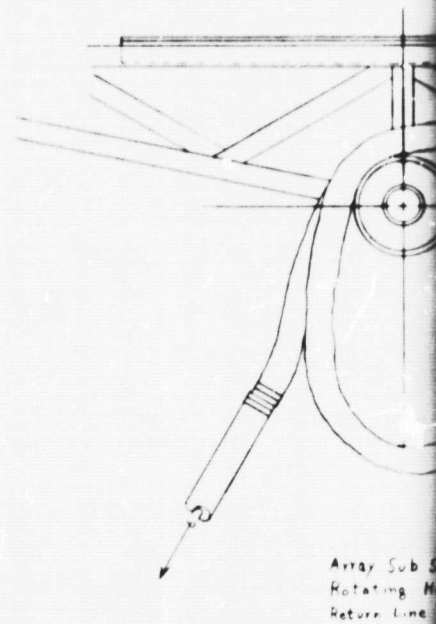


Array Sub Section Electrically  
operated Chain Drive - with  
position Locking Device

Position Locking  
Device

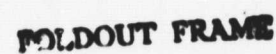
Gear Motor Drive

FOLDOUT FRAME



Array Sub S  
Rotating M  
Return Line





5/4/76  
TO: [illegible]  
FROM: [illegible]  
SUBJECT: [illegible]  
[illegible]  
[illegible]  
[illegible]

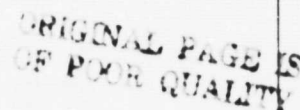
[illegible]

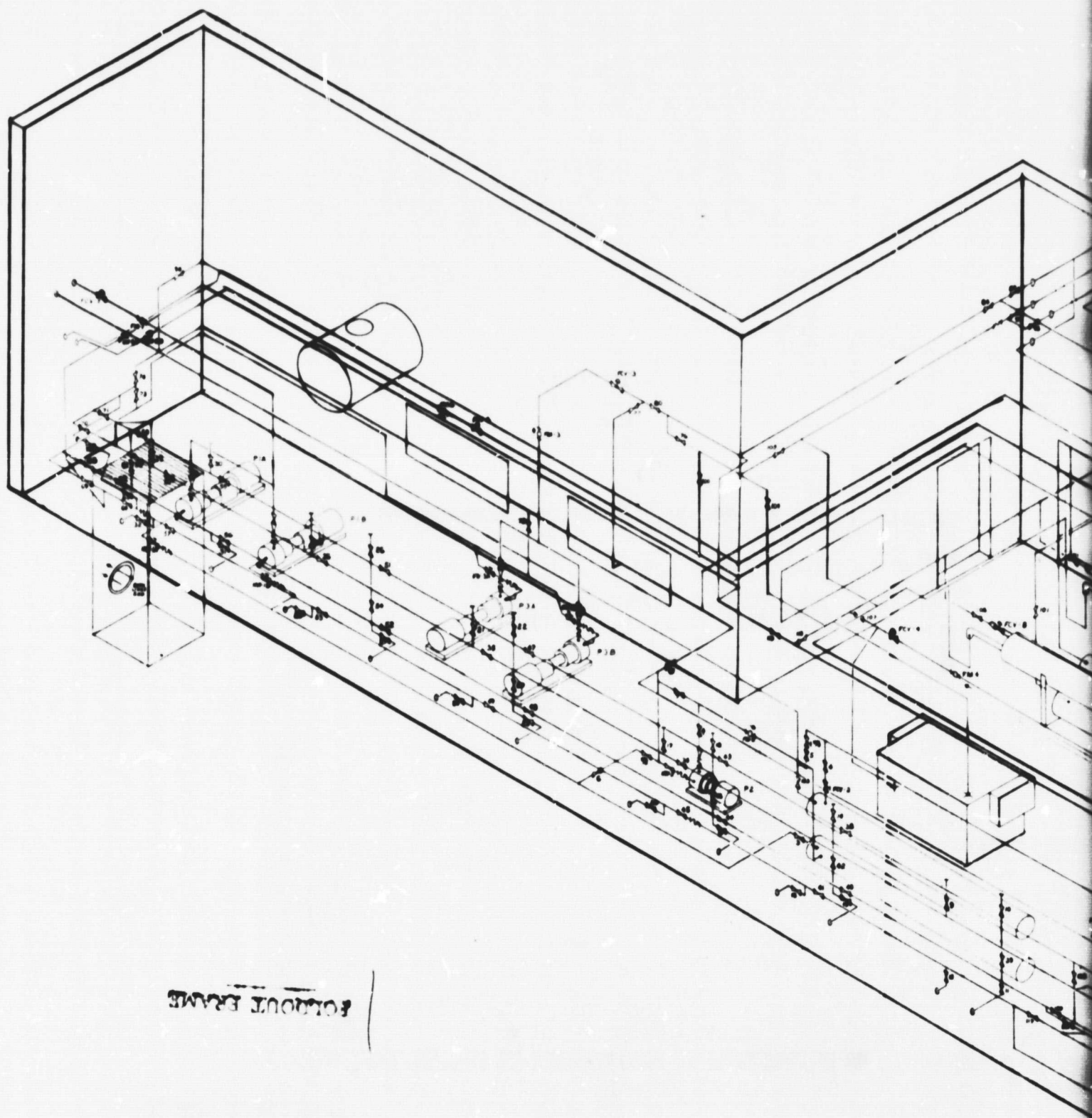
|                   |  |               |                       |
|-------------------|--|---------------|-----------------------|
| TO: <b>WALL</b>   | <b>CONTROLS Inc.</b>                             |               | <b>Marineport, Md</b> |
| FROM: <b>WALL</b> | <b>Information sent</b>                          | <b>as</b>     | <b>W 66</b>           |
| <b>0</b>          |  | <b>Method</b> | <b>6/18</b>           |
| <b>0</b>          | <b>Wall Array Section - Sub Station - Drive</b>  |               |                       |
| <b>0</b>          | <b>and Motor Connection enlarged - Collector</b> |               |                       |
| <b>0</b>          | <b>and section</b>                               |               |                       |
| <b>0</b>          | <b>KRL Bldg L-A-HW-AC-100</b>                    |               |                       |

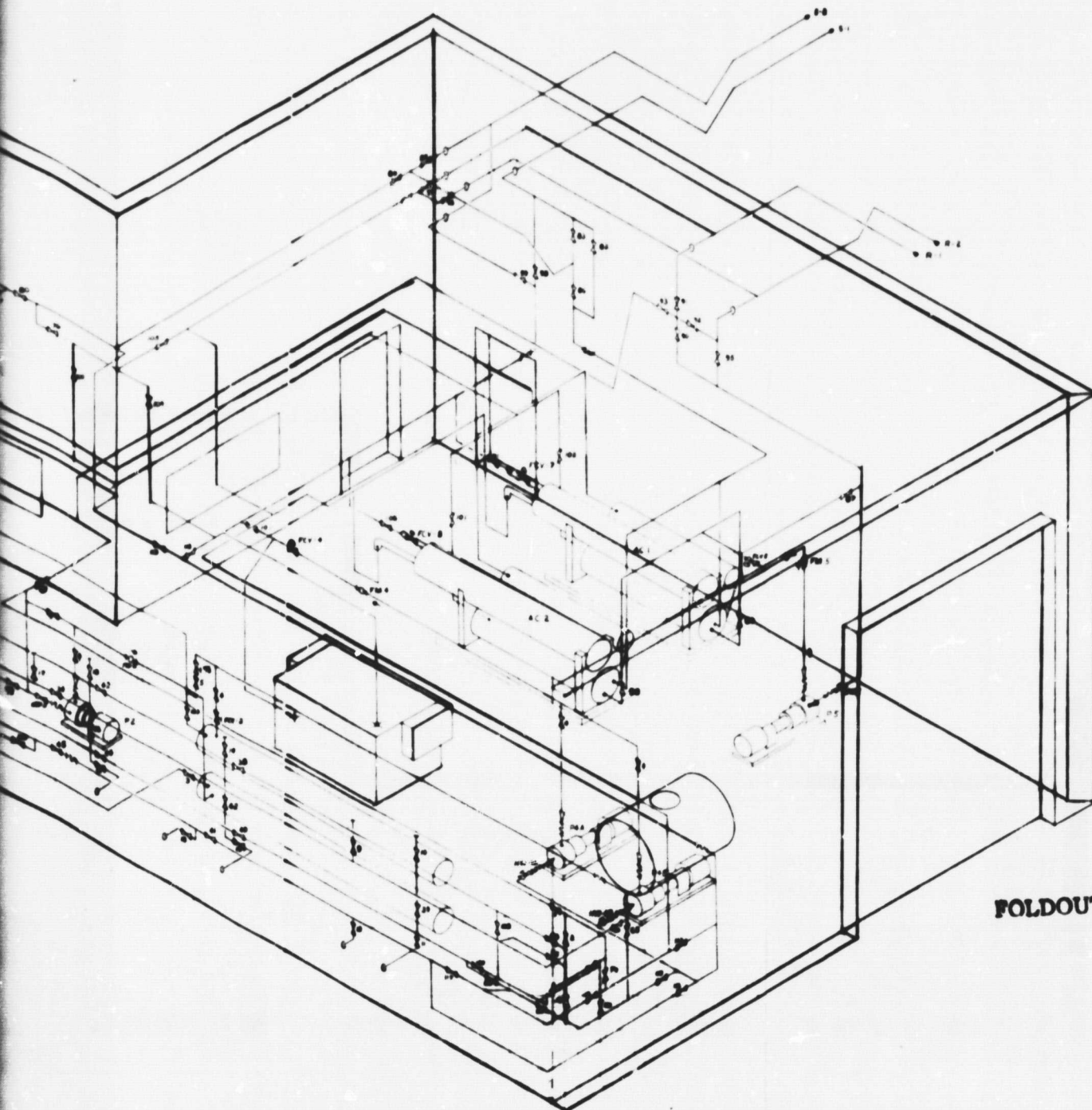




360°  
ROTATION  
(BI-DIRECTIONAL)

[illegible]



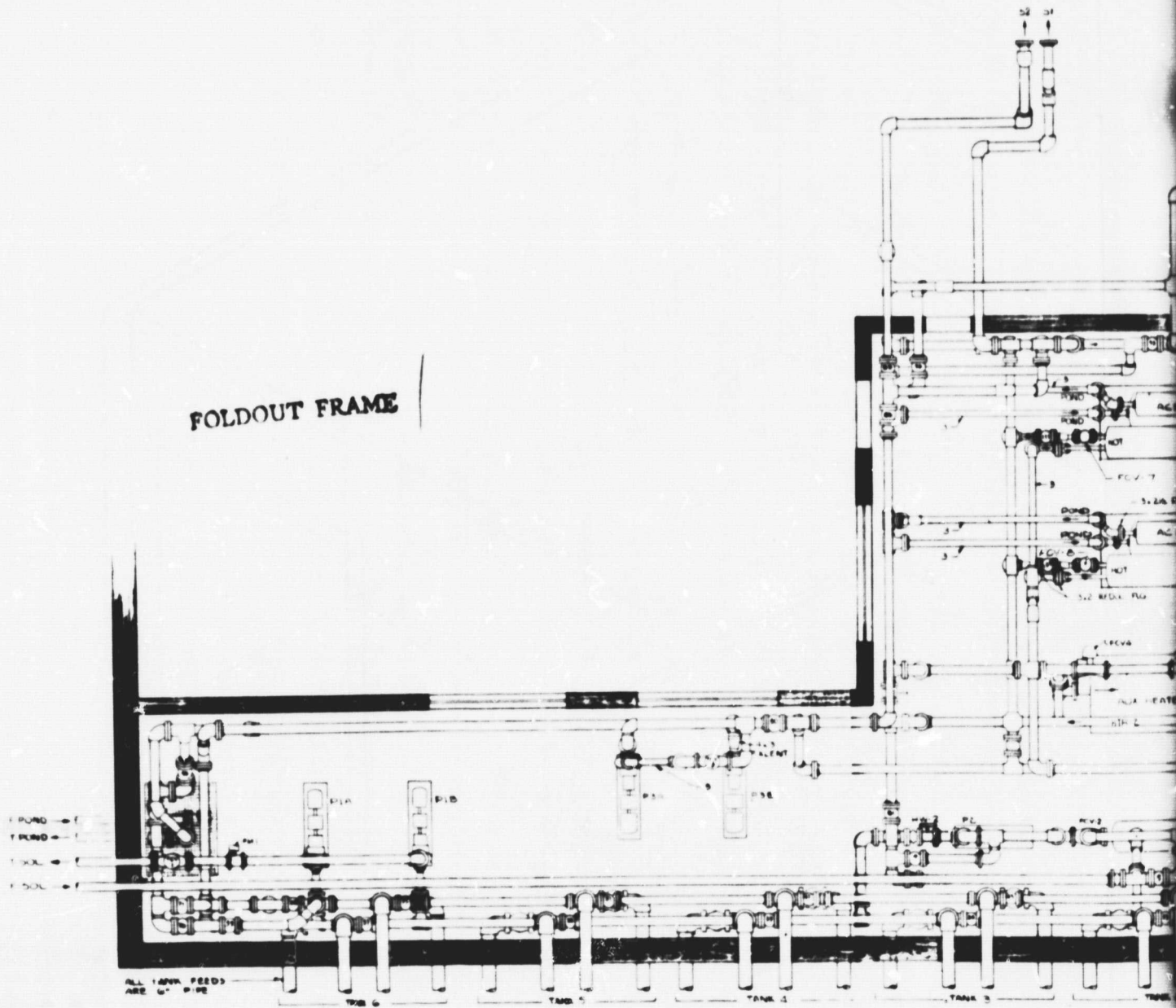


FOLDOUT FRAME

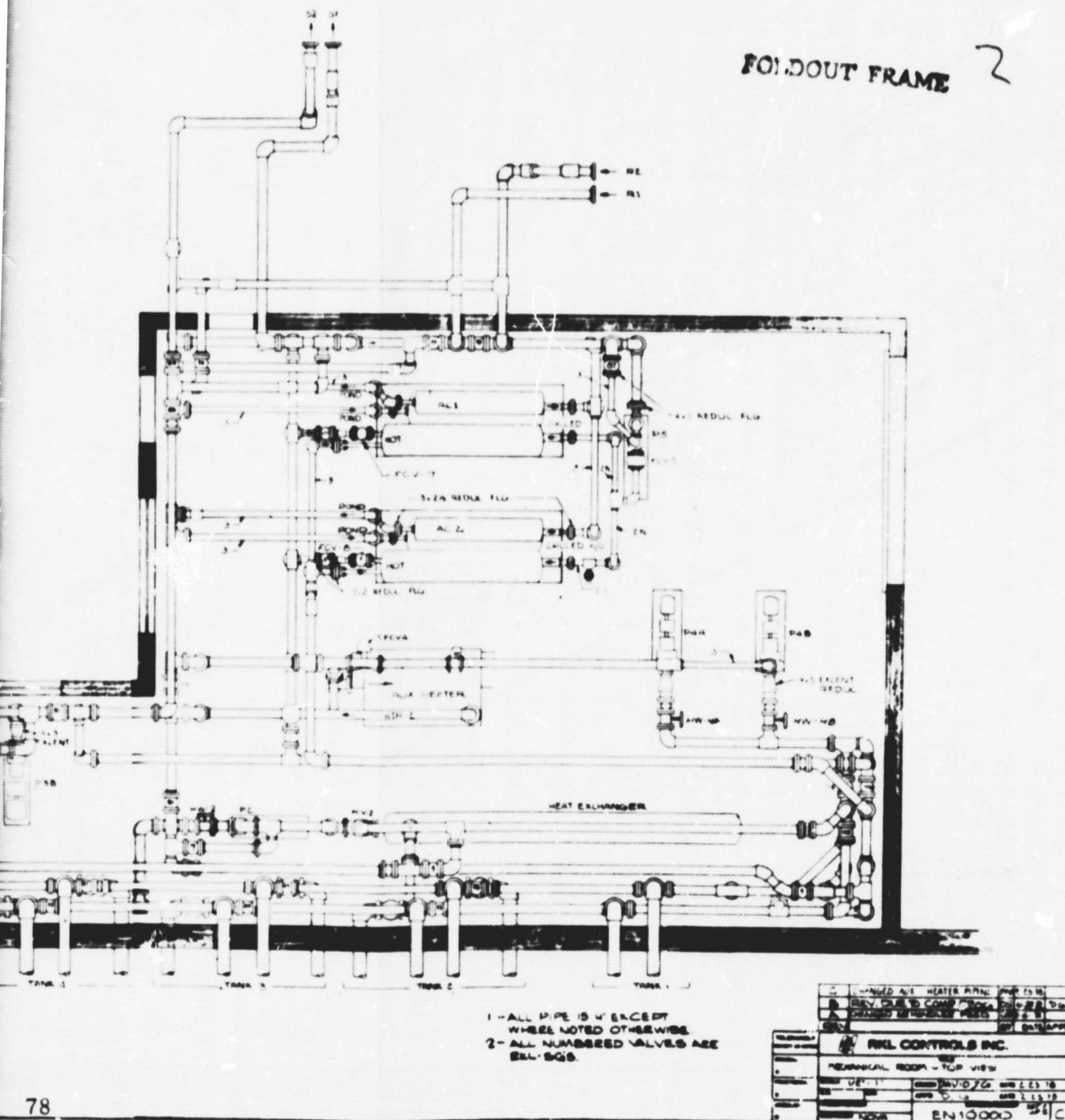
|     |            |            |            |
|-----|------------|------------|------------|
| 1   | WIRING 1   | WIRING 1   | WIRING 1   |
| 2   | WIRING 2   | WIRING 2   | WIRING 2   |
| 3   | WIRING 3   | WIRING 3   | WIRING 3   |
| 4   | WIRING 4   | WIRING 4   | WIRING 4   |
| 5   | WIRING 5   | WIRING 5   | WIRING 5   |
| 6   | WIRING 6   | WIRING 6   | WIRING 6   |
| 7   | WIRING 7   | WIRING 7   | WIRING 7   |
| 8   | WIRING 8   | WIRING 8   | WIRING 8   |
| 9   | WIRING 9   | WIRING 9   | WIRING 9   |
| 10  | WIRING 10  | WIRING 10  | WIRING 10  |
| 11  | WIRING 11  | WIRING 11  | WIRING 11  |
| 12  | WIRING 12  | WIRING 12  | WIRING 12  |
| 13  | WIRING 13  | WIRING 13  | WIRING 13  |
| 14  | WIRING 14  | WIRING 14  | WIRING 14  |
| 15  | WIRING 15  | WIRING 15  | WIRING 15  |
| 16  | WIRING 16  | WIRING 16  | WIRING 16  |
| 17  | WIRING 17  | WIRING 17  | WIRING 17  |
| 18  | WIRING 18  | WIRING 18  | WIRING 18  |
| 19  | WIRING 19  | WIRING 19  | WIRING 19  |
| 20  | WIRING 20  | WIRING 20  | WIRING 20  |
| 21  | WIRING 21  | WIRING 21  | WIRING 21  |
| 22  | WIRING 22  | WIRING 22  | WIRING 22  |
| 23  | WIRING 23  | WIRING 23  | WIRING 23  |
| 24  | WIRING 24  | WIRING 24  | WIRING 24  |
| 25  | WIRING 25  | WIRING 25  | WIRING 25  |
| 26  | WIRING 26  | WIRING 26  | WIRING 26  |
| 27  | WIRING 27  | WIRING 27  | WIRING 27  |
| 28  | WIRING 28  | WIRING 28  | WIRING 28  |
| 29  | WIRING 29  | WIRING 29  | WIRING 29  |
| 30  | WIRING 30  | WIRING 30  | WIRING 30  |
| 31  | WIRING 31  | WIRING 31  | WIRING 31  |
| 32  | WIRING 32  | WIRING 32  | WIRING 32  |
| 33  | WIRING 33  | WIRING 33  | WIRING 33  |
| 34  | WIRING 34  | WIRING 34  | WIRING 34  |
| 35  | WIRING 35  | WIRING 35  | WIRING 35  |
| 36  | WIRING 36  | WIRING 36  | WIRING 36  |
| 37  | WIRING 37  | WIRING 37  | WIRING 37  |
| 38  | WIRING 38  | WIRING 38  | WIRING 38  |
| 39  | WIRING 39  | WIRING 39  | WIRING 39  |
| 40  | WIRING 40  | WIRING 40  | WIRING 40  |
| 41  | WIRING 41  | WIRING 41  | WIRING 41  |
| 42  | WIRING 42  | WIRING 42  | WIRING 42  |
| 43  | WIRING 43  | WIRING 43  | WIRING 43  |
| 44  | WIRING 44  | WIRING 44  | WIRING 44  |
| 45  | WIRING 45  | WIRING 45  | WIRING 45  |
| 46  | WIRING 46  | WIRING 46  | WIRING 46  |
| 47  | WIRING 47  | WIRING 47  | WIRING 47  |
| 48  | WIRING 48  | WIRING 48  | WIRING 48  |
| 49  | WIRING 49  | WIRING 49  | WIRING 49  |
| 50  | WIRING 50  | WIRING 50  | WIRING 50  |
| 51  | WIRING 51  | WIRING 51  | WIRING 51  |
| 52  | WIRING 52  | WIRING 52  | WIRING 52  |
| 53  | WIRING 53  | WIRING 53  | WIRING 53  |
| 54  | WIRING 54  | WIRING 54  | WIRING 54  |
| 55  | WIRING 55  | WIRING 55  | WIRING 55  |
| 56  | WIRING 56  | WIRING 56  | WIRING 56  |
| 57  | WIRING 57  | WIRING 57  | WIRING 57  |
| 58  | WIRING 58  | WIRING 58  | WIRING 58  |
| 59  | WIRING 59  | WIRING 59  | WIRING 59  |
| 60  | WIRING 60  | WIRING 60  | WIRING 60  |
| 61  | WIRING 61  | WIRING 61  | WIRING 61  |
| 62  | WIRING 62  | WIRING 62  | WIRING 62  |
| 63  | WIRING 63  | WIRING 63  | WIRING 63  |
| 64  | WIRING 64  | WIRING 64  | WIRING 64  |
| 65  | WIRING 65  | WIRING 65  | WIRING 65  |
| 66  | WIRING 66  | WIRING 66  | WIRING 66  |
| 67  | WIRING 67  | WIRING 67  | WIRING 67  |
| 68  | WIRING 68  | WIRING 68  | WIRING 68  |
| 69  | WIRING 69  | WIRING 69  | WIRING 69  |
| 70  | WIRING 70  | WIRING 70  | WIRING 70  |
| 71  | WIRING 71  | WIRING 71  | WIRING 71  |
| 72  | WIRING 72  | WIRING 72  | WIRING 72  |
| 73  | WIRING 73  | WIRING 73  | WIRING 73  |
| 74  | WIRING 74  | WIRING 74  | WIRING 74  |
| 75  | WIRING 75  | WIRING 75  | WIRING 75  |
| 76  | WIRING 76  | WIRING 76  | WIRING 76  |
| 77  | WIRING 77  | WIRING 77  | WIRING 77  |
| 78  | WIRING 78  | WIRING 78  | WIRING 78  |
| 79  | WIRING 79  | WIRING 79  | WIRING 79  |
| 80  | WIRING 80  | WIRING 80  | WIRING 80  |
| 81  | WIRING 81  | WIRING 81  | WIRING 81  |
| 82  | WIRING 82  | WIRING 82  | WIRING 82  |
| 83  | WIRING 83  | WIRING 83  | WIRING 83  |
| 84  | WIRING 84  | WIRING 84  | WIRING 84  |
| 85  | WIRING 85  | WIRING 85  | WIRING 85  |
| 86  | WIRING 86  | WIRING 86  | WIRING 86  |
| 87  | WIRING 87  | WIRING 87  | WIRING 87  |
| 88  | WIRING 88  | WIRING 88  | WIRING 88  |
| 89  | WIRING 89  | WIRING 89  | WIRING 89  |
| 90  | WIRING 90  | WIRING 90  | WIRING 90  |
| 91  | WIRING 91  | WIRING 91  | WIRING 91  |
| 92  | WIRING 92  | WIRING 92  | WIRING 92  |
| 93  | WIRING 93  | WIRING 93  | WIRING 93  |
| 94  | WIRING 94  | WIRING 94  | WIRING 94  |
| 95  | WIRING 95  | WIRING 95  | WIRING 95  |
| 96  | WIRING 96  | WIRING 96  | WIRING 96  |
| 97  | WIRING 97  | WIRING 97  | WIRING 97  |
| 98  | WIRING 98  | WIRING 98  | WIRING 98  |
| 99  | WIRING 99  | WIRING 99  | WIRING 99  |
| 100 | WIRING 100 | WIRING 100 | WIRING 100 |



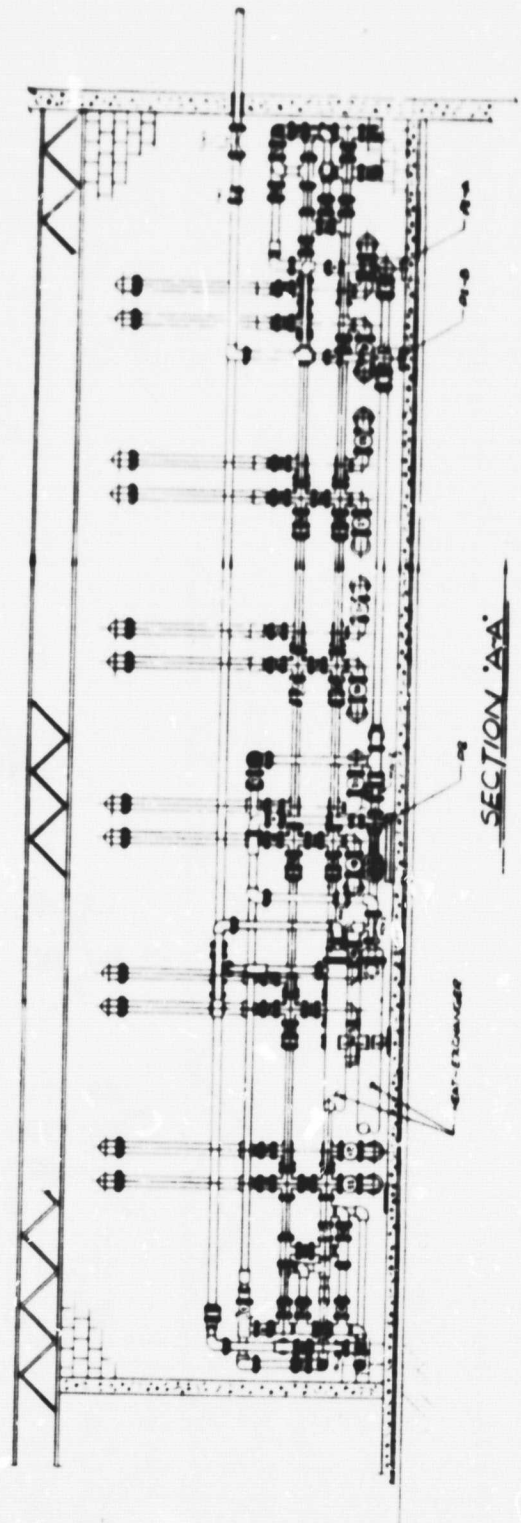
FOLDOUT FRAME



FOLDOUT FRAME 2

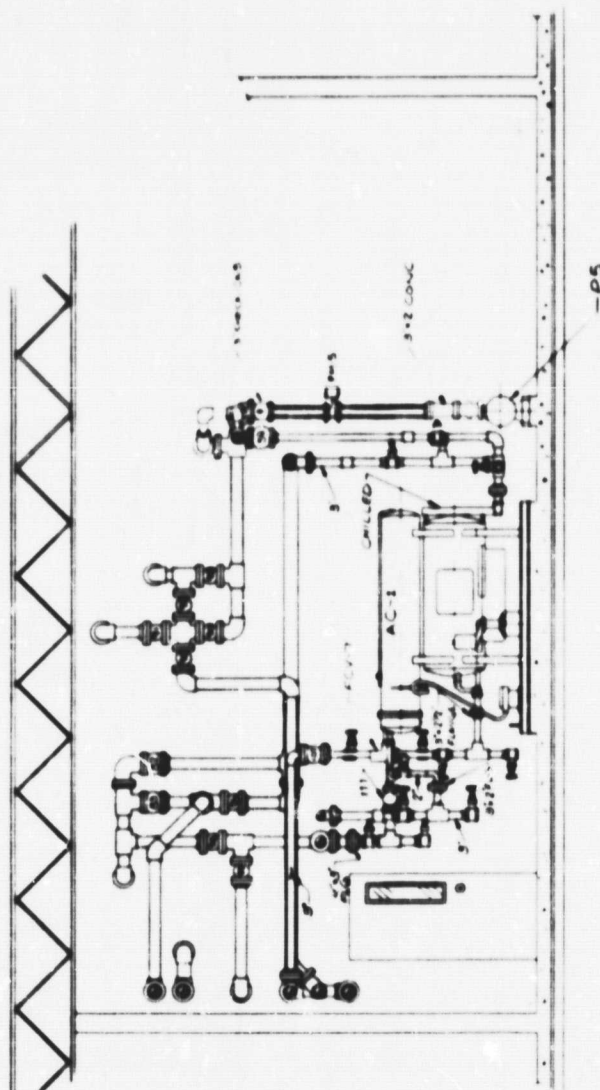


NOTE: ALL DIMS. / EXCEPT AS NOTED  
 ALL MARKED DIMS. ARE IN INCHES



SECTION 'AA'

|   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |     |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|



**NOTES:**  
 ALL DIMS. & EXCEPT AS NOTED  
 ALL NUMBERED VALVES ARE 1/2\"/>

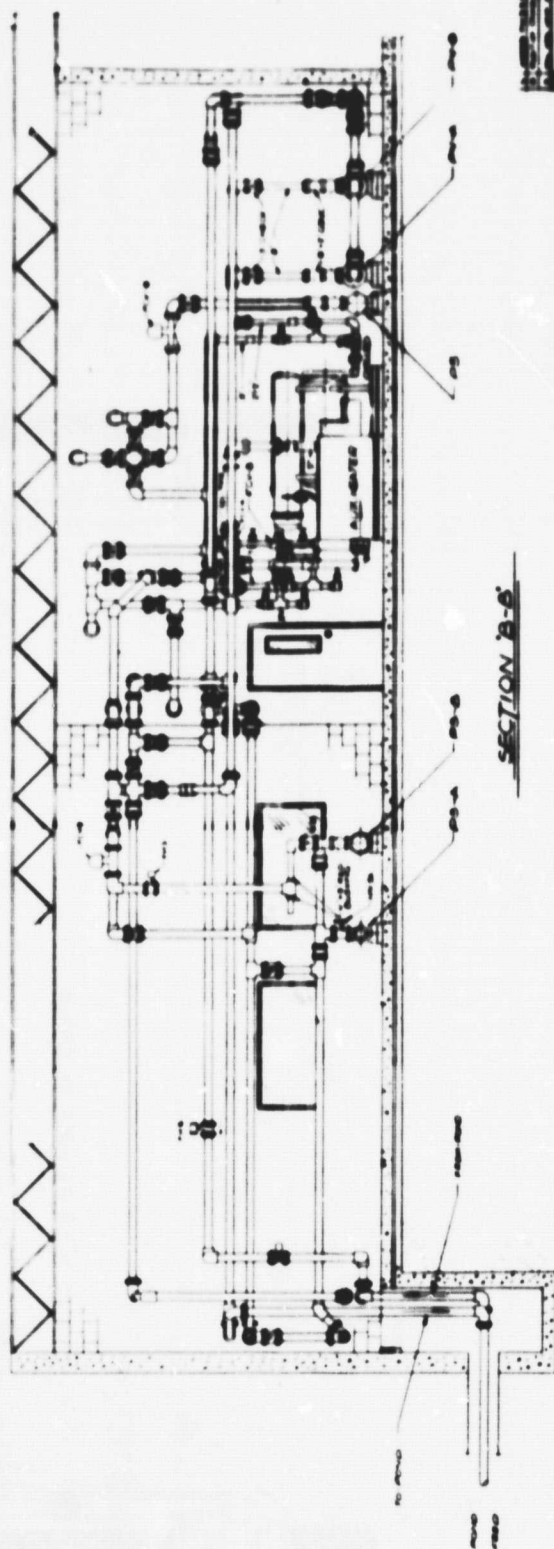
|   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |     |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|

**SECTION C-C**

**ORIGINAL PAGE IS  
 OF POOR QUALITY**



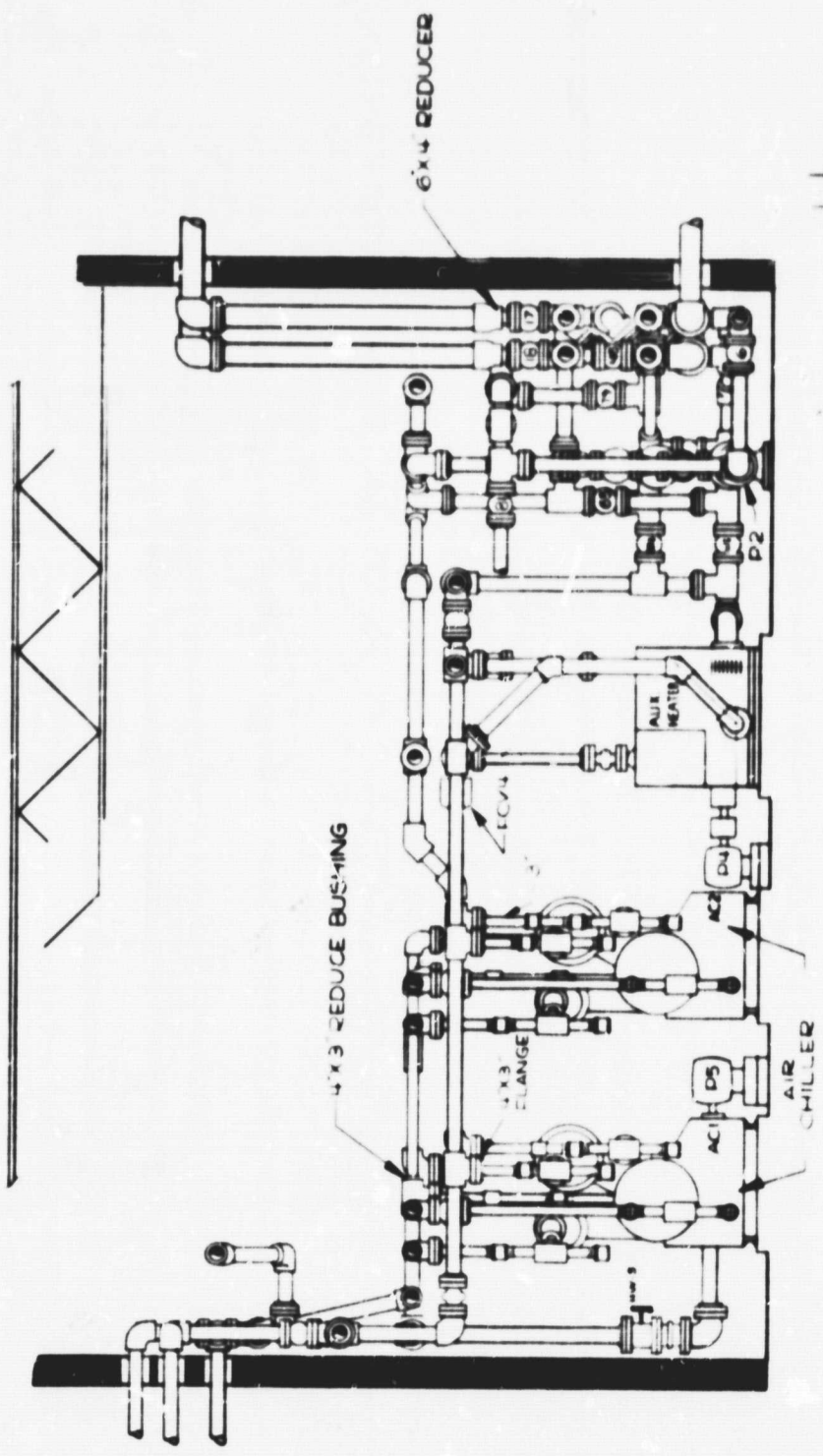
|   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |     |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|



1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40. 41. 42. 43. 44. 45. 46. 47. 48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60. 61. 62. 63. 64. 65. 66. 67. 68. 69. 70. 71. 72. 73. 74. 75. 76. 77. 78. 79. 80. 81. 82. 83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93. 94. 95. 96. 97. 98. 99. 100.



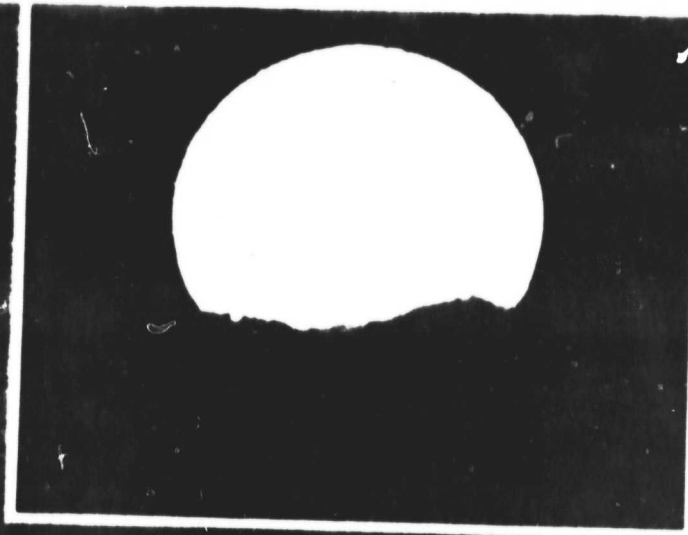
NOTE. 1 ALL PIPING ARE 4" UNLESS OTHERWISE NOTED.  
2 ALL NAMED VALVES ARE BRL-563



SECTION D-D

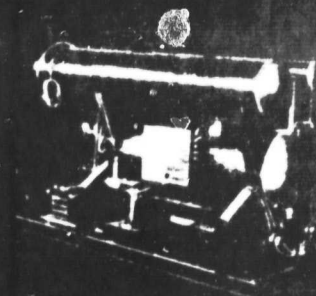
|                             |  |      |      |
|-----------------------------|--|------|------|
| CHILLED PIPES TO AIR HEATER |  | 1000 | 1000 |
| AIR HEATER                  |  | 1000 | 1000 |
| AIR CHILLER                 |  | 1000 | 1000 |
| MECHANICAL ROOM PIPING      |  | 1000 | 1000 |
| BRL CONTROLS INC.           |  | 1000 | 1000 |
| CH-0003                     |  | 1000 | 1000 |
| D                           |  | 1000 | 1000 |





# **solaire<sup>®</sup>** **300**

25 ton  
Absorption Chiller  
for Solar Air  
Conditioning



**ARKLA** **solaire<sup>®</sup>**

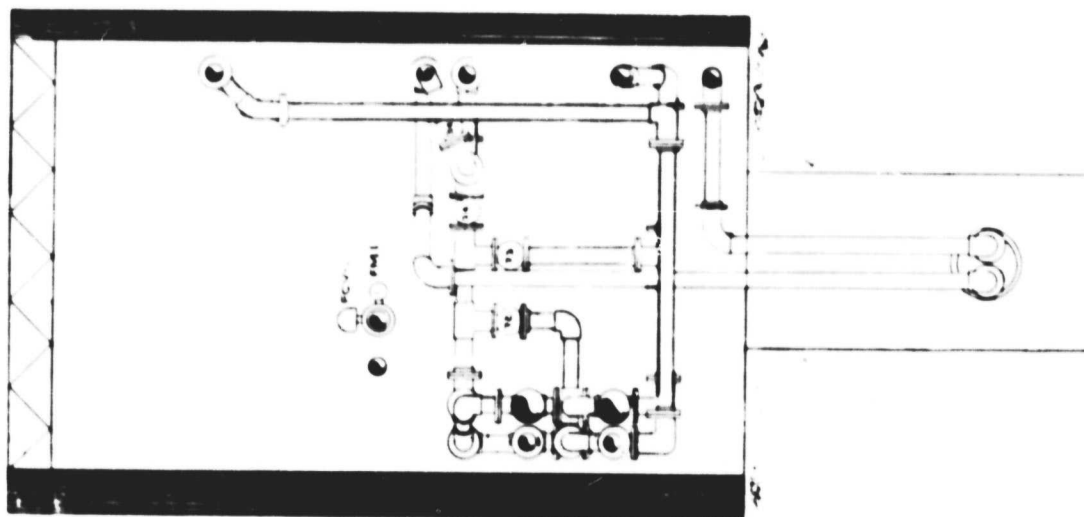
SUN POWERED AIR CONDITIONING  
A product of Arkla Industries Inc.



**NOTE**

**Electronics**

[illegible]



## SECTION J-J

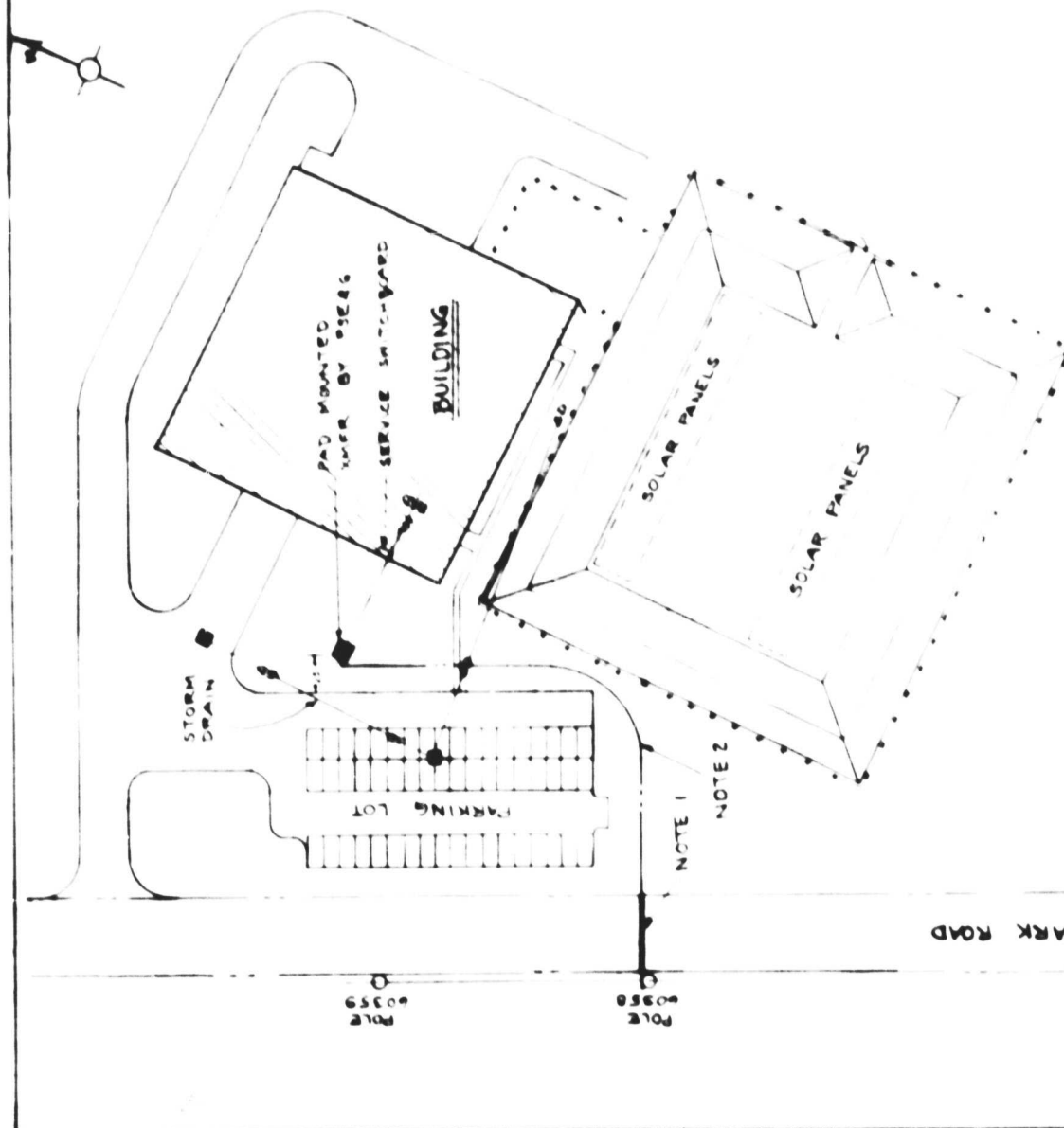
NOTES:

- 1-ALL PIPE W/ EXCEPT AS NOTED  
2-ALL NUMBERED VALVES ARE ALL 30"3.

**RAIL CONTROLS INC.**

MECHANICAL ROOM DIPPING

1/2" x 1" **PAUL H. SCHMIDT** **CN 10002**



# NOTES

1. CONTRACTOR SHALL PROVIDE 4" CONDUIT UNDER STREET, GRC OR PVC
2. 3-1/2" 15 KV POLY CABLE US 48 SHOWN BY DWG. BY PS AT PS EXPENSE TRENCHING BY PS AT OWNER'S EXPENSE
3. PULL PARALLELED SECONDARY LATERALS IN NUMBERED CONDUITS IN THE FOLLOWING NUMBERED ORDER AS MAY BE APPLICABLE: 1, 2, 5, 6, 3, 7, 4, 8

# REFERENCES

- (1) PSE&G SKETCH 5-832 DATED 9/1/77, ENTITLED RKL CONTROL INC
- (2) DIAGRAM OF TYPICAL INSTALLATION 30 PAD MOUNTED AMPS DWG M-8178-A, DATED 2/24/75, (3) SPECS FOR CUSTOMER INSTALLED UNDERGROUND SERVICE CONDUIT DWG M-8031 DATED 6/1/77, (4) SERVICE RUNS - SECONDARY CONNECTIONS TO PS EQUIPMENT W/ 36 1"7, DATED 7/1/75, (5) SERVICE RUNS - 30 PAD MOUNTED AMPS INSTALLATIONS ON ZONE DWG M-8172, DATED 9/1/76

RKL CONTROLS INC  
OFFICES AND PLANT  
SERVICE - ELECTRICAL SYSTEM

## INSTALLER INFORMATION

CONTRACTOR COMPANY

400 MAIN STREET

ROCKY HILL, CT 06067

GUSTAVE A NYLANDER

PROPOSED DWG. 010-10004

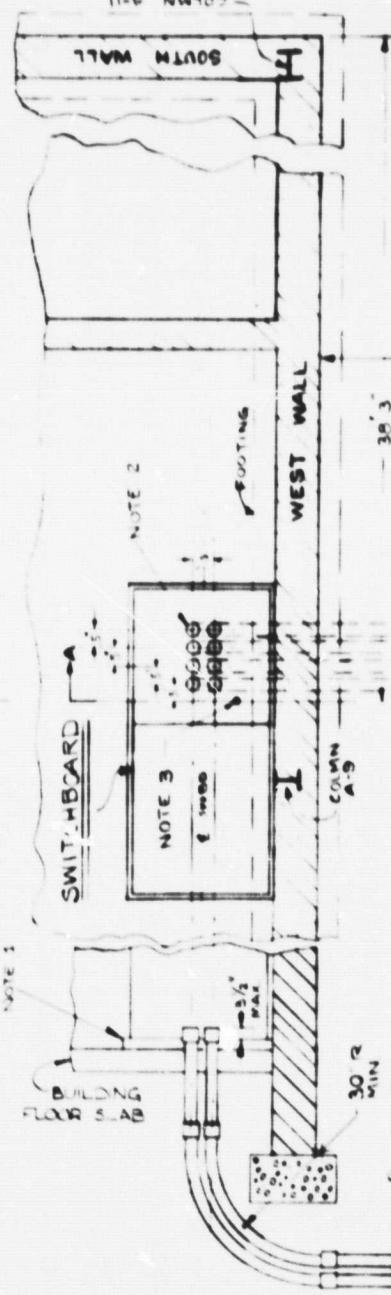
27 LC 9406 NY LC 10073 PA LC 100002

| DATE  | BY    | DATE     | BY    |
|-------|-------|----------|-------|
| 4-77  | GRAND | 4-77     | GRAND |
| APPRO | SCALE | NO.      | NO.   |
| 100   | 100   | DN-10004 |       |



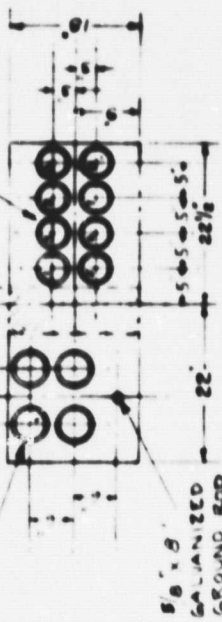
# NOTES

1. MOUNT SWITCHBOARD ON MASONRY PEDESTAL RISING 3' ABOVE FLOOR SLAB
2. SECONDARY CONDUITS ENTER BUILDING AND SWITCHBOARD FROM BELOW GRADE ON DIMENSIONAL PATTERN OF DETAIL 1 EXCEPT CENTERED ON FULL ENTRY AREA OF SWITCHBOARD
3. DRIVE UL LISTED NONFERROUS GROUND ROD TO MIN DEPTH OF 8 FEET. GROUNDING ELECTRODE CONDUCTOR 3/8 MINIMUM BOND FOOTING  $\phi$ s TO GROUND ROD AS AVAILABLE. BOND COLUMN A-9 TO GROUND ROD

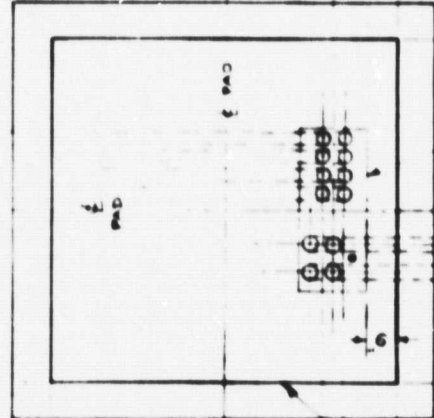


AREA OF PARKING LOT  
PAD 25' FROM PAVED

PRIMARY CONDUITS  
4-4" CARLON  
TYPE 40 PV DUT

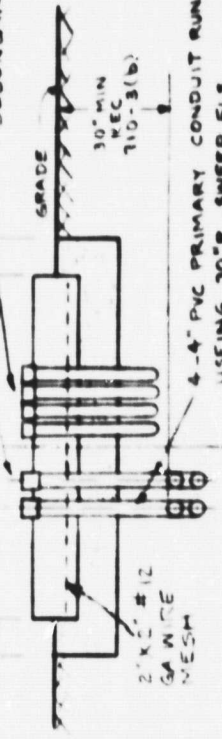


DETAIL 1



DETAIL 2

CONDUIT STUBUPS:  
PRIMARY - 4"  
SECONDARY - 6"



4-4" PVC PRIMARY CONDUIT RUNS  
USING 30" R SWEEP ELS

PSE 66 TYPE III A  
XMF R PAD PER PSE 66  
DWG & DA 11-16-1096

RKL CONTROLS INC  
OFFICES AND PLANT  
SERVICE - ELECTRICAL SYSTEM

RYLANDER ENGINEERING

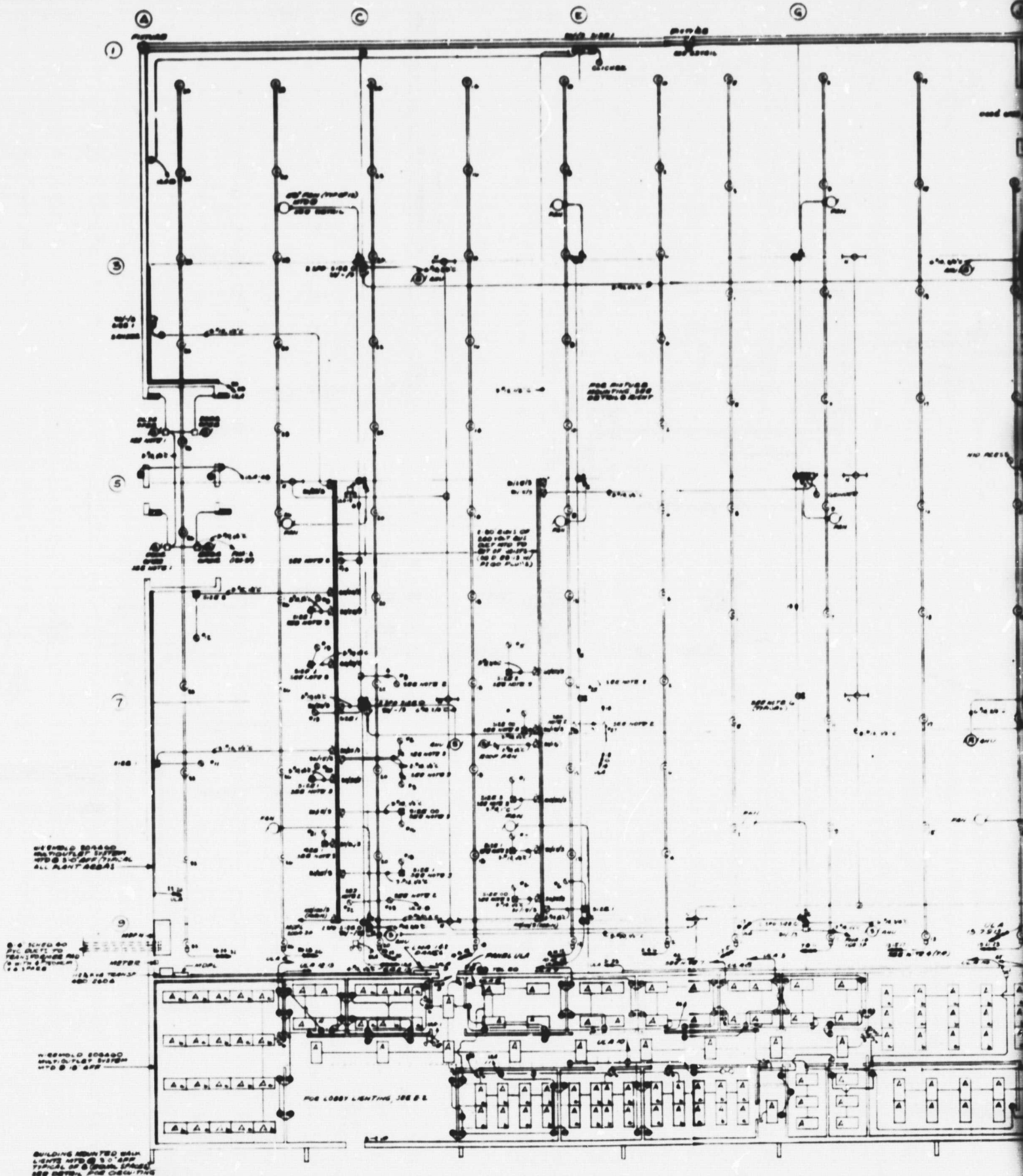
CONSULTING ENGINEER  
400 WEST STREET  
NEWARK, N.J. 07102

USA

GUSTAVE A. NYLANDER  
PROFESSIONAL ENGINEER

N.J. LIC 0496 N.Y. LIC 33475 PA. LIC 10000E

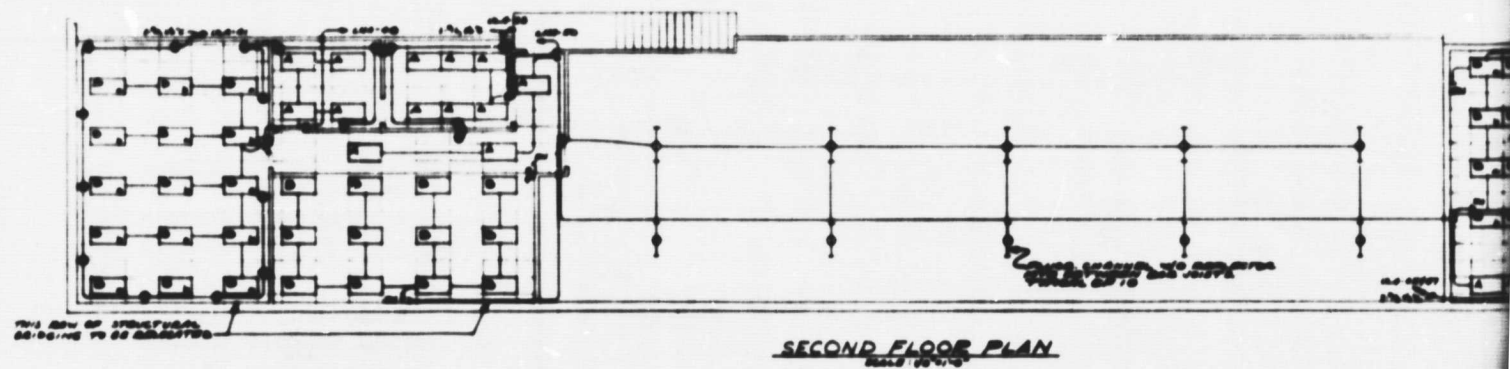
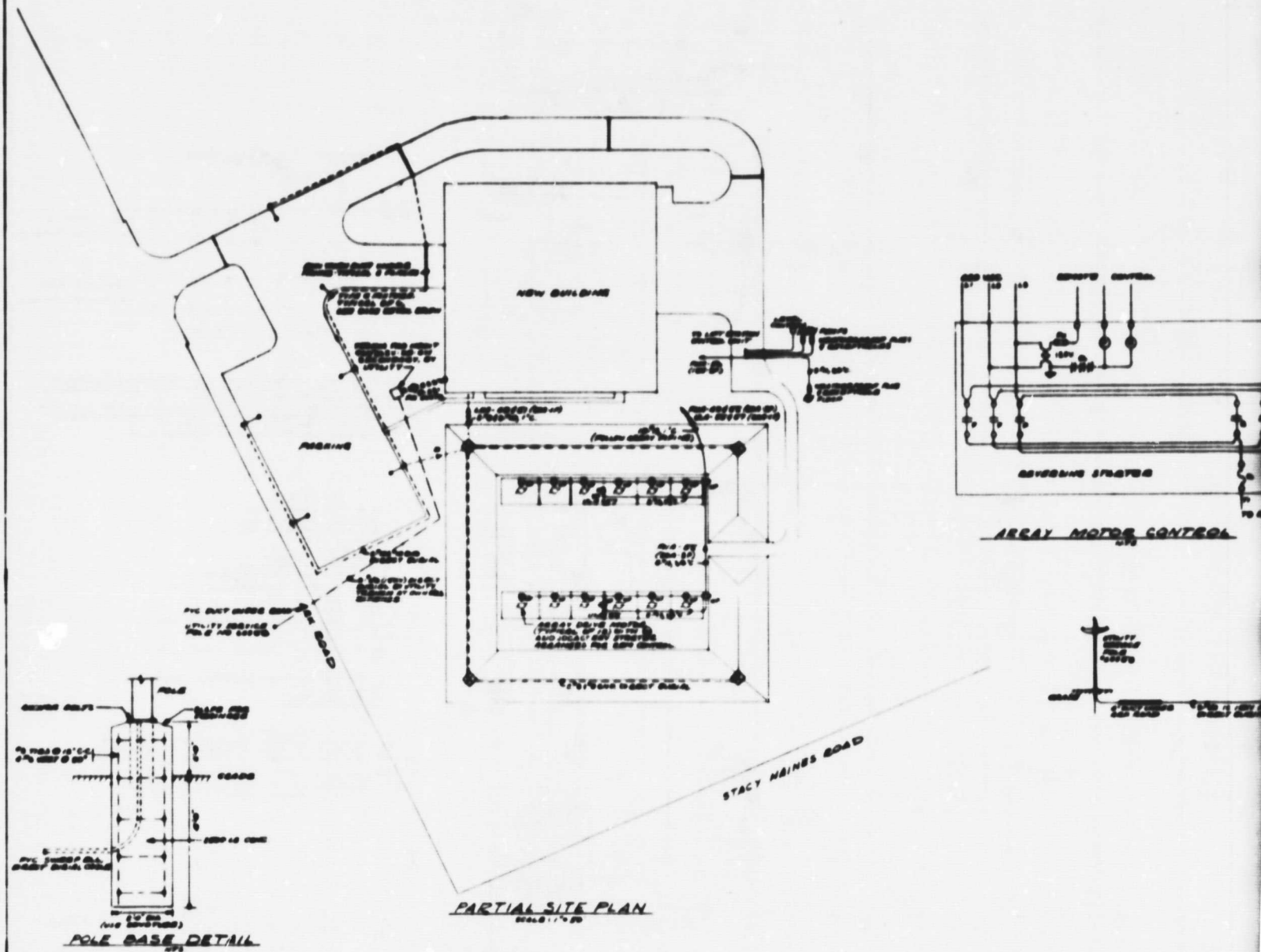
|        |         |       |     |       |              |
|--------|---------|-------|-----|-------|--------------|
| DATE   | 1-4-77  | DRAWN | GAN | CHECK |              |
| APP'D  |         | REP   |     |       |              |
| SCALE  | 1/8"=1' |       |     |       |              |
| DWG NO |         |       |     |       | SHEET 1 OF 2 |
| NO     |         |       |     |       | 07-100-97    |



**FOLDOUT FRAMES**



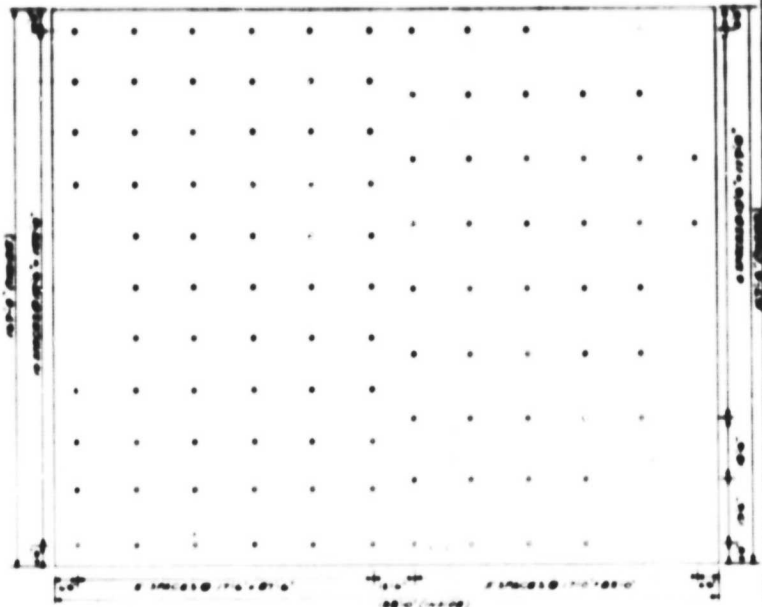




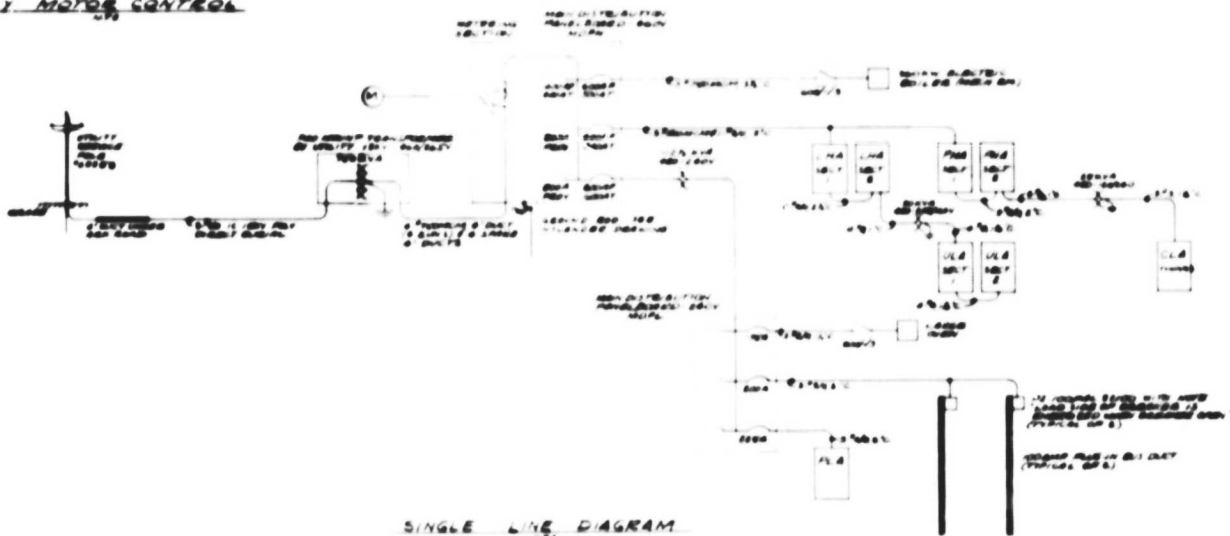
## FOLDOUT FRAME



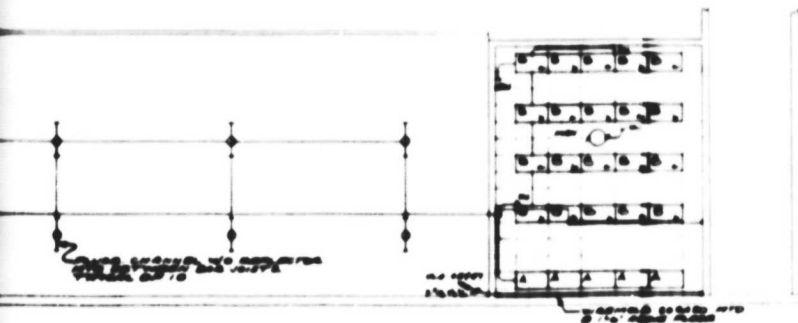
ARRAY MOTOR CONTROL



LIGHTING LAYOUT



SINGLE LINE DIAGRAM



ARRAY LIGHTING CONTROL

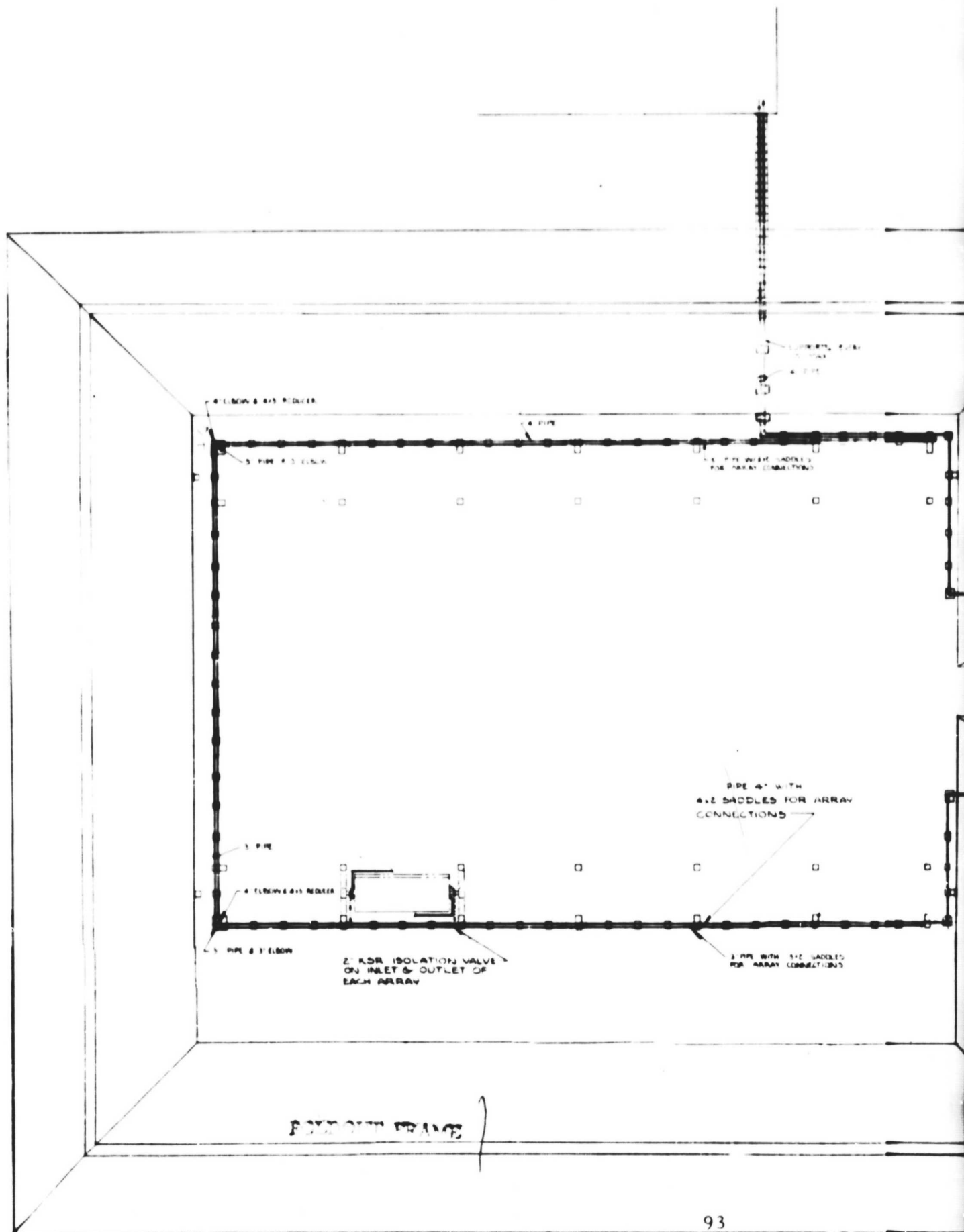
FOLDOUT FRAME 2

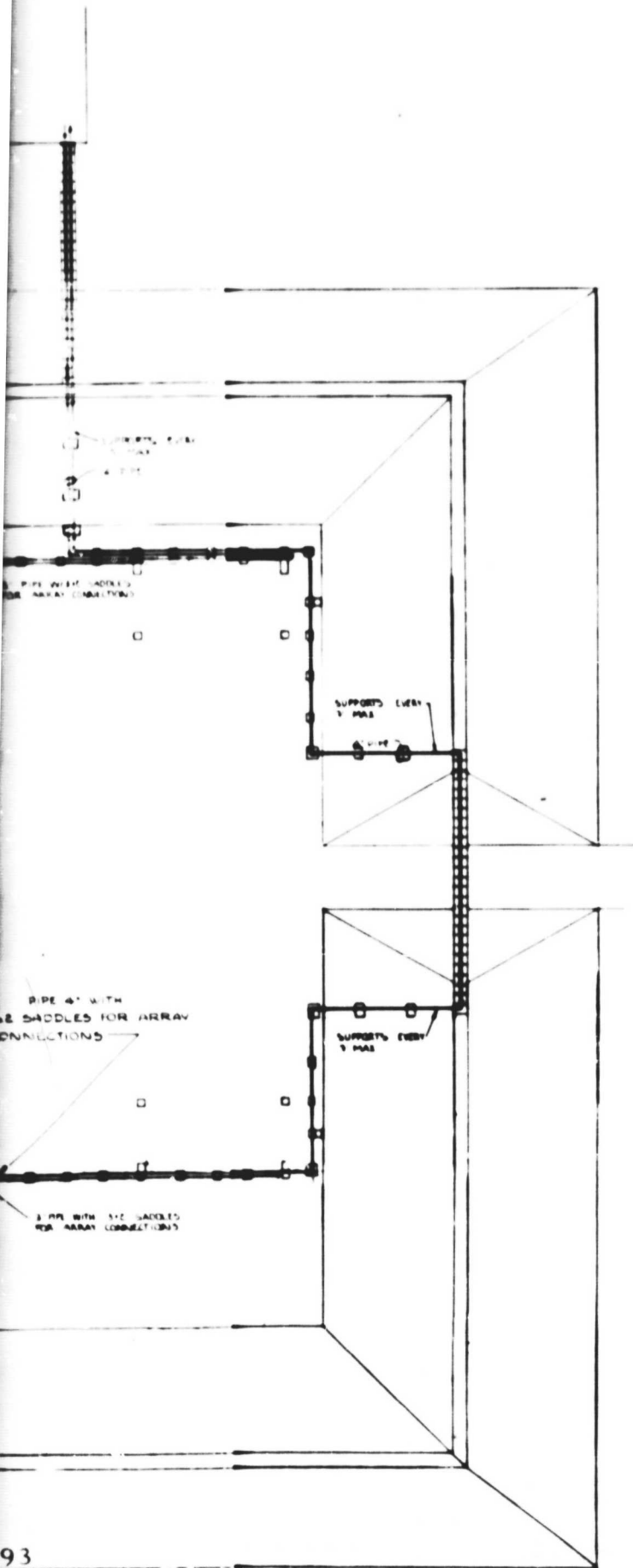
|  |     |
|--|-----|
| FREDERICK W. HICKNEY P.E.              |     |
| Electrical Engineer                    |     |
| ELECTRICAL SITE, 2 <sup>ND</sup> FLOOR |     |
| RKL CONTROLS                           | E-2 |





**FLYING SAUCERS**

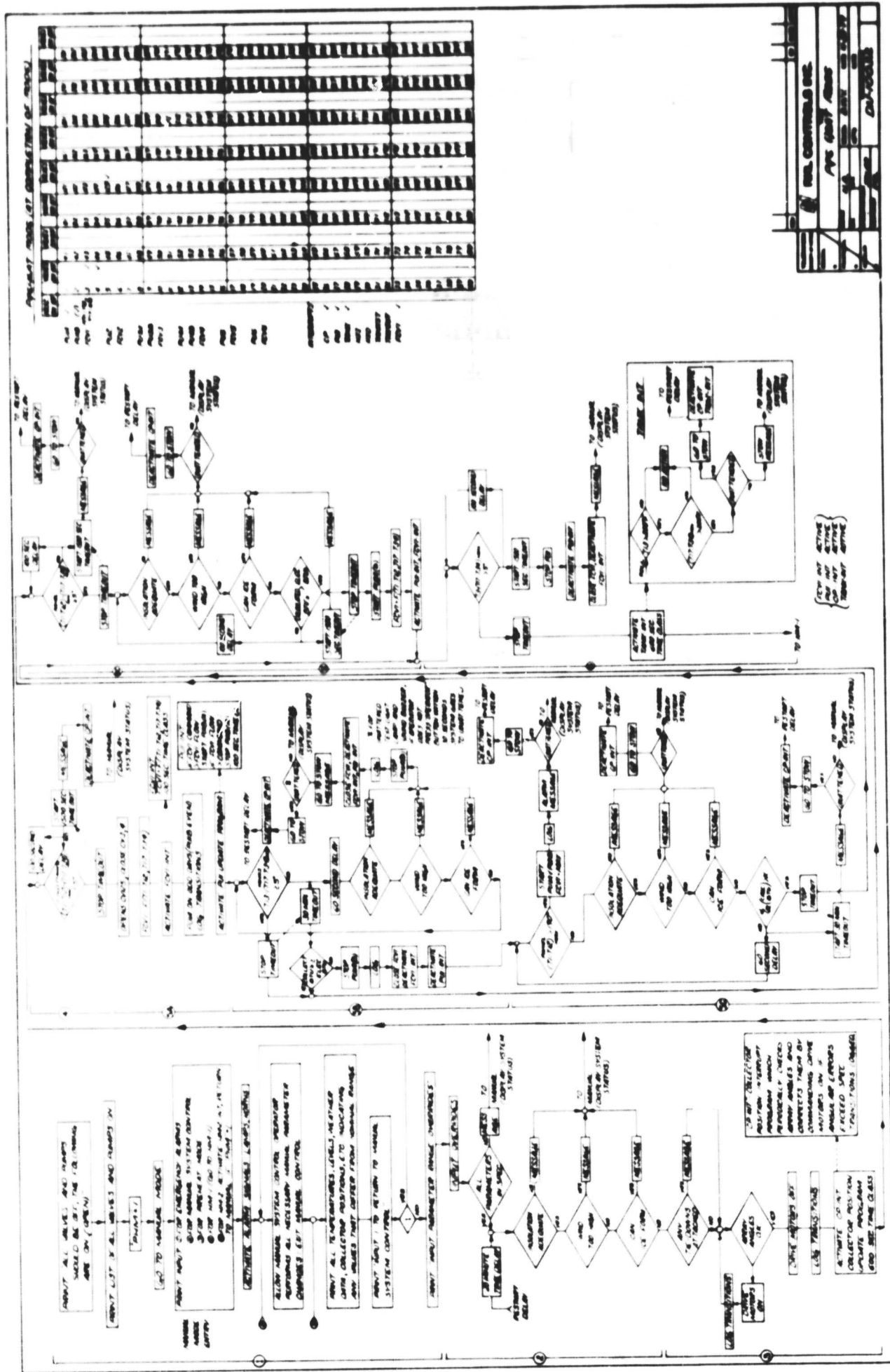




BUILDOUT FRAME 2

|                            |              |
|----------------------------|--------------|
| ALBION PIPING - ADDED LINE |              |
| RSL CONTROLS INC.          |              |
| ARRAY PIPING PLAN          |              |
| DATE                       | BY           |
| 10/1/81                    | J. H. HARRIS |
| EN 10005                   |              |

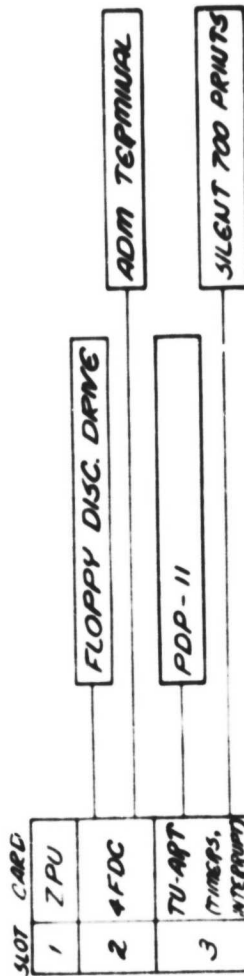








- (1) 9 56TPA - LMD SAGED - LMD DIP -  
 EAPM. APSS. - PYPHOMETER  
 (2) 12 COLLECTOR POSITION

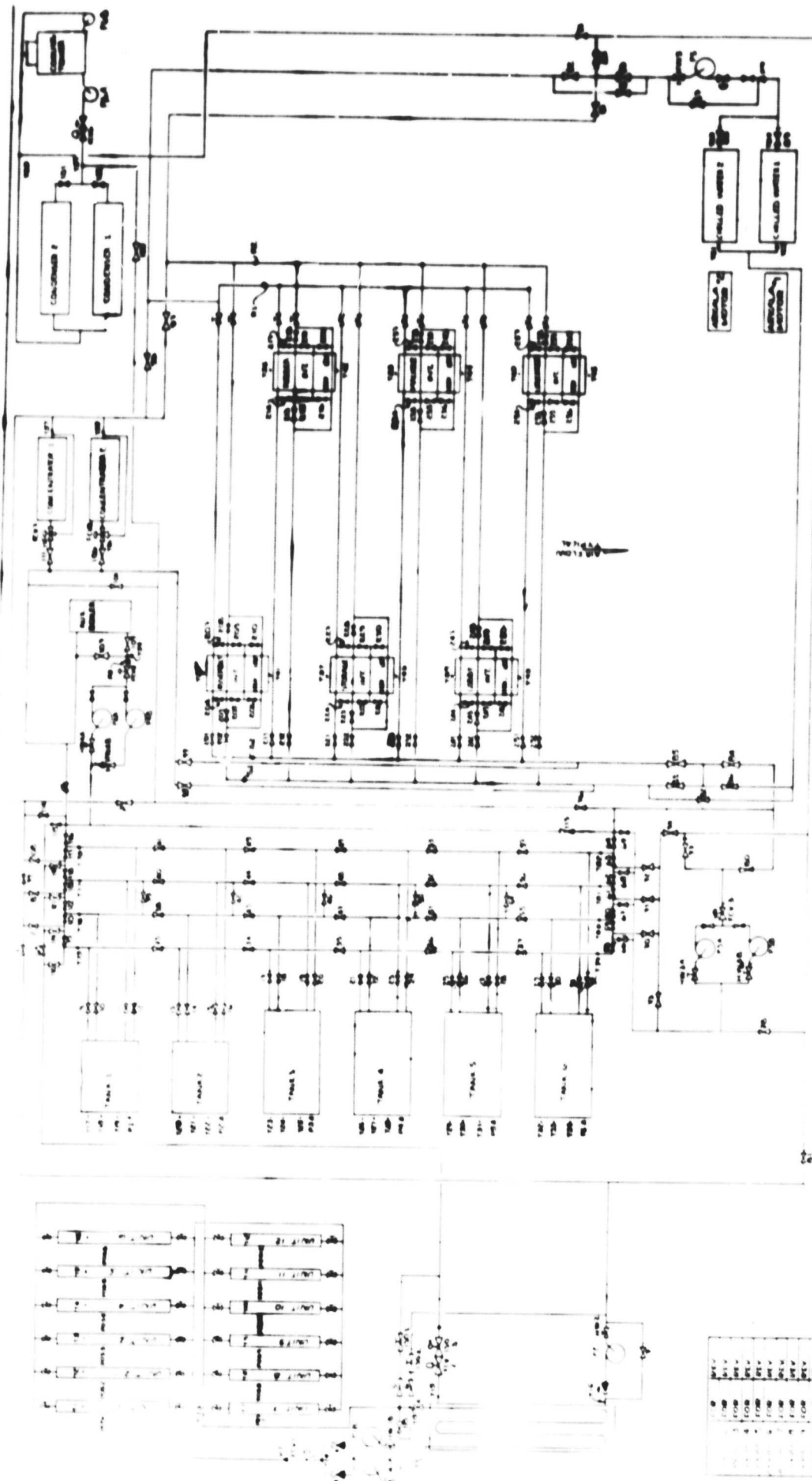


| SLOT CARD | DIGITAL PORT ADDRESSES  | ANALOG PORT ADDRESSES | AVAIL | ACTUAL        |
|-----------|-------------------------|-----------------------|-------|---------------|
| 1 ZPU     |                         |                       |       |               |
| 2 4FDC    |                         |                       |       |               |
| 3 TU-ART  |                         |                       |       |               |
| 4 16K     |                         |                       |       |               |
| 5 16K     |                         |                       |       |               |
| 6 16K     |                         |                       |       |               |
| 7 8K      |                         |                       |       |               |
| 8 8K      |                         |                       |       |               |
| 9 D-7A    | 7 BRIDGE / MUX 105:111D | STD. THERMISTORS 80   | 71    | (113:105)     |
| 10 D-7A   | 3 BRIDGE / MUX 112:114D | TRW THERM 16          | 12    | (113:105)     |
|           | 2 BRIDGE / MUX 115:116D | HUMIDITY BRIDGE 8     | 3     |               |
|           | 1 BRIDGE / MUX 117D     | VOLTS IN 16           | 13    | (11)          |
|           | 2 VOLTAGE MUX 121:122D  | VOLTS IN 16           | 13    | (12)          |
|           | 2 VOLTAGE MUX 123:124D  | FLOW VOLTS IN 8       | 6     |               |
|           | 1 VOLTAGE MUX 125D      | VOLTS OUT 7           | 6     |               |
| 12 D-7A   | 7 ANALOG OUT 137:143D   | DIGITAL A.C. OUT      | 320   |               |
| 13 8PIO   | 256 256                 |                       |       | 2 ANALOG      |
| 14 8PIO   | TTL TO 256              |                       |       | 21 ANALOG     |
| 15 8PIO   | OAC5 150LATORS          |                       |       | 24 ANALOG     |
| 16 8PIO   | INTERFACE               |                       |       | 11 PUMPS      |
| 17 8PIO   |                         |                       |       | 14 PUMPS      |
|           |                         |                       |       | 1 BOILER      |
|           |                         |                       |       | 2 THERMISTORS |
|           |                         |                       |       | 2 PUMPS       |
|           |                         |                       |       | 267           |

|                        |        |         |          |         |       |
|------------------------|--------|---------|----------|---------|-------|
| 0 UNITS                |        | 1 UNITS |          | 2 UNITS |       |
| A                      | UNITS  | A       | UNITS    | A       | UNITS |
| RKI CONTROLS INC.      |        |         |          |         |       |
| SOLAR COMPUTER SYSTEM  |        |         |          |         |       |
| COMPUTER BLOCK DIAGRAM |        |         |          |         |       |
| SCALE                  | 0.01K  | DATE    | 12-10-74 |         |       |
| U.A.                   | U.M.A. | DATE    | 1-15-75  |         |       |
| BU10034                |        |         |          |         |       |

\* NOT YET RECEIVED OR ORDERED.





1. Project Name: \_\_\_\_\_  
 2. Drawing Title: \_\_\_\_\_  
 3. Drawing Number: \_\_\_\_\_  
 4. Revision: \_\_\_\_\_  
 5. Date: \_\_\_\_\_  
 6. Drawn By: \_\_\_\_\_  
 7. Checked By: \_\_\_\_\_  
 8. Approved By: \_\_\_\_\_  
 9. Scale: \_\_\_\_\_  
 10. Sheet Number: \_\_\_\_\_ of \_\_\_\_\_

| Symbol | Description | Quantity |
|--------|-------------|----------|
| 1      | Relay       | 1        |
| 2      | Switch      | 1        |
| 3      | Sensor      | 1        |
| 4      | Motor       | 1        |
| 5      | Transformer | 1        |
| 6      | Capacitor   | 1        |
| 7      | Resistor    | 1        |
| 8      | Diode       | 1        |
| 9      | Inductor    | 1        |
| 10     | Transistor  | 1        |

SOLAR COLLECTORS

# *SUN*WORKS

SPECIALISTS IN SOLAR ENERGY EQUIPMENT

ORIGINAL PAGE IS  
OF POOR QUALITY

*solector*



P.O. BOX 1004 • NEW HAVEN, CONNECTICUT 06508 • (203) 934-6301

RKL Controls, Incorporated  
Construction Division  
Hainesport Industrial Park  
Hainesport, NJ 08036

Bid Proposal & Specification Dates March 1, 1977

1. Description of Project:

2. Collector Area Requested: 6,604.5 ft<sup>2</sup> (effective)

3. No. of Collectors: 357

4. Dimensions of Collector Panel:

Type - Flat Plate Water Cooled

Length - 7'0"

Width - 2' - 11 1/2"

Thickness - 4"

Weight of Single Glass Collector - 110 lbs. dry, 114 lbs. wet,  
or 5.50 lbs./sq.ft.

Weight of Double Glass Collector - 134 lbs. dry, 138 lbs. wet,  
or 6.63 lbs./sq.ft.

Net Glass Area Per Panel (Aperture) - 18.88 sq.ft.

Net Absorber Area Per Panel - 18.50 sq.ft.

Ratio of Usable Absorber Area to Total Surface Covered - 0.89

5. Absorber:

Type of Metal for Absorber Surface - Copper Sheet: 0.01 thick  
Surface - Selective Black manufactured by Enthone, Inc.

Absorptivity - Minimum of .87/.92

Emissivity - Maximum of .07/.35

Maximum Allowable Temperature - Over 400°F

Copper Tubes - 1/4" (0.375 O.D.) Type "L" Copper

Tube Spacing - 4" O.C.



Tube Pattern - Grid Vertical to Manifold  
Manifold - 1" (1.125 O.D.) Type "M" Copper  
Tube Connections to Sheet - Soft Solder  
Tube Connections to Manifold - Brazing Alloy  
Connection to External Piping - 1" Nominal x  
1<sup>3</sup>/<sub>8</sub>" long Nipple Type "M" Copper Extending 0.31 Beyond  
Collector sides: Supply Lower Right and Left - Return  
Upper Right and Left  
Thermal Isolation - Complete Isolation Between Absorber  
and Assembly

6. Expansion/Contraction:

Absorber Tube/Sheet has Horizontal Movement Tolerance of  
Plus or Minus 1/4" at Header Supply and Return Connections.

7. Glass Cover:

Optical Properties of Cover - 92% Solar Transmittance  
Thickness - 3/16" Single Glass, 1/8" Double Glass  
Type - Tempered, Soda Lime, Water White (with Alum Spacer  
and Moisture/Ultra Violet Protective Seal & Dessicated in  
Double Glass Unit)  
Edges - Swiped  
Air Space Between Double Glass Layers - 1/2"

8. Gasketing Material:

Glass - "U" Shape Neoprene Gasket Continuous at All Sides

9. Insulation Data:

Material - Fiberglass Over Foil Faced Urethane  
Thickness - 1" Foil Faced Urethane and 1" Fiberglass  
Thermal Properties - R=10  
Density - 1.2 lbs./ft.<sup>3</sup> for Fiberglass

10. Collector Frame:

Sides - Extruded Aluminum : Finish - mill  
Bottom - Aluminum Sheet 0.05 Thickness  
Glass Lock - Extruded Aluminum Finish - mill  
Connectors - Stainless Steel and Aluminum  
Corners - Mitered and Sealed

11. Hydraulic Data:

Material in Contact with Circulating Fluid - Copper  
Recommended Flow Rate - 1.75 gph/sq.ft. = 598 GPM/Panel  
Absorber Plate or 0.54 gpm per Collector  
Flow Resistance - Negligible at Above Rate

12. Methods of Anchoring:

Attachment - Keyway in side of collector along perimeter of frame to  
accept "U" clips with holes for bolt mounting to roof or frame. Optional  
1 1/4" mounting leg integral with top and bottom of frame, 4 holes provide.



**Sunworks**, specialists in solar energy equipment and systems, is a division of Enthone, Inc., a leading supplier in the plating and metal finishing industry. Enthone is a subsidiary of ASARCO Incorporated, one of the world's largest smelters and refiners of non-ferrous metals. Together, they combine their historical leadership in developing quality products for the solar energy industry.

Founded in 1973, Sunworks is one of the first companies in the United States to be exclusively devoted to solar equipment design and production. Through a joint business venture with Enthone, Incorporated, a subsidiary of ASARCO, Sunworks has established modern facilities in Connecticut and New Jersey to provide manufacturing, research, engineering, and technical service for

\*Patents Pending

solar equipment. Sunworks is also able to supply experienced, technically oriented personnel to assist you with cost-reducing recommendations for your specific solar project.

## Sunworks Products

Sunworks manufactures both liquid cooled and air cooled flat plate solar collectors\*, and packaged solar domestic water heaters\* suitable for both new and retrofit installations.

The Sunworks flat-plate collector module, called the *Selector*\*\* solar energy collector (Patents Pending), has been developed for solar systems that require high thermal efficiency, long-term performance, and minimum installed cost per BTU delivered. The high efficiency of the *Selector*\* solar energy collector is due in part to the exclusive Enthone selective surface on the absorber. This coating assures high absorption of the

\*\*Trademark of Enthone, Inc.

sun's radiation and low emittance of thermal radiation. The *Selector* solar energy collector can be incorporated with good efficiency into systems that utilize heat up to 240°F. It can be used for domestic water heating, space heating, space cooling, pool heating, laundry drying, crop drying, paper drying, snow melting, low temperature steam production, process heat, and distillation.

The Sunworks packaged solar domestic water heating systems, *Selector* Paks, are available from Sunworks representatives in various system configurations that can be connected to new or existing domestic water heating systems. The basic *Selector* Pak includes two 3' x 7' liquid cooled *Selectors* solar energy collectors, storage vessel, circulator, control logic, sensors, fittings and valves unique to the system, installation diagrams and instructions. See your Sunworks representative for system selection and sizing.

## Consulting Services

**System Design.** Because of the high initial cost of solar heating and cooling systems, equipment must be carefully sized to the requirements of each application based upon solar insolation, environmental conditions, energy requirements and economics.

The size and the calculated performance of the Sunworks packaged domestic water heater can be easily determined by local representatives. A list of Sunworks representatives is available on request from Sunworks or by calling Sweet's Catalog toll-free Buyline Number (800) 255-6880.

Application of solar energy collectors to space heating or air conditioning in buildings normally requires a system designed by a qualified mechanical engineer who is licensed to practice in the locality of the building. Sunworks architectural and engineering staff, through the local Sunworks representative, is available to provide consulting services to qualified architects, engineers, and contractors involved in solar system design.

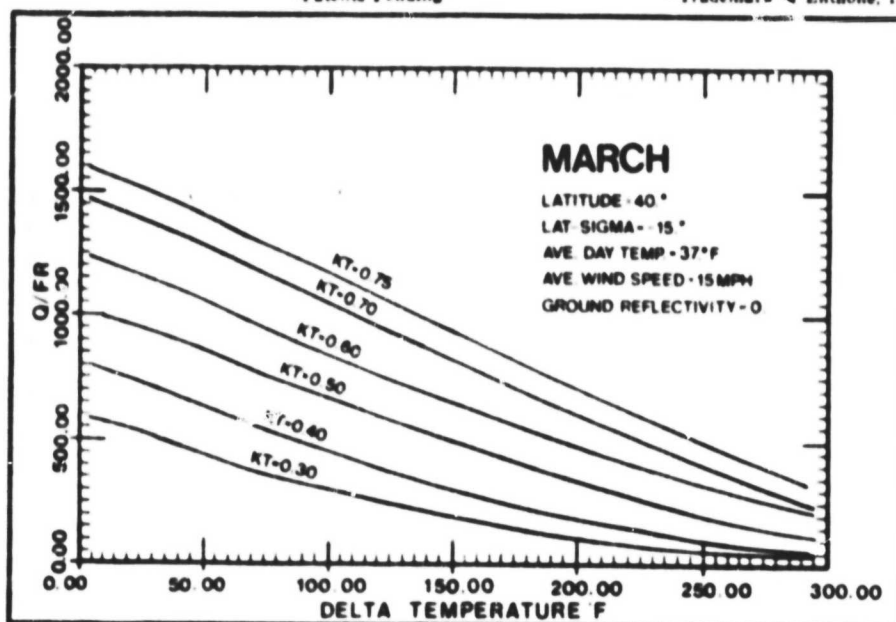


FIGURE 1.

**EXAMPLE:** To calculate the installed cost per million BTU's per month of a given collector the following procedure may be used. The curves plotted in Figure 1 are based upon the monthly average performance of the Sunwork *Selector*\* solar energy collector under conditions of 15 mph wind, during March, at a latitude of 40°N and a tilt of latitude plus 15° (optimum for space heating). For an average temperature rise of 100°F. above the outside ambient, the *Selector* solar energy collector can deliver 720 BTU × °F./ft² per day under average cloud cover conditions ( $K_t = .53$ ) for March. ( $K_t$  averaged for lat. 40°). Using an  $F_r = .90$  (forced circulation, single glazed liquid), the collector can deliver 648 BTU/ft² per day × 31 day/month = 20,088 BTU/ft² per month. One million BTU's per month divided by 20,088 = 49.78 ft² of *Selector* solar energy collector required. For a collector cost of \$11 per square foot of usable absorber area plus \$1 per square foot for installation, the cost per million BTU's in March is \$597.37.  
(for double glazed liquid *Selector*,  $F_r = .93$ )  
(for air cooled *Selector*,  $F_r = .85$ )

**Computer Analyses.** Sunworks has developed computer programs for determining the performance of the *Solector* solar energy collector. Hour-by-hour computer analyses are available to compute performance for different localities and different tilts, orientations and row spacings (See Figure 1.). Sunworks is able to read most N.O.A.A. weather data tapes; customer furnishes tape. A fee is charged for consulting and computer services.

## Sunworks Publications

Sunworks publishes and periodically updates several technical booklets covering the design of solar systems for buildings. A basic information pamphlet, *Solar Energy Q's and A's*, and a complete publication list are available without charge. Please include a stamped, self-addressed envelope. Current Sunworks publications that are available include:

- 01 Design Criteria for Solar Heated Buildings \$10.00
- 03 Adapting Design to Climate \$ .75
- 04 Alternate Energy Sources \$ .75

(Please add \$.50 mailing charge. Connecticut residents add 7% sales tax.)

## Features of the Solector Solar Energy Collector

**1. Availability in Various Models.** The *Solector* solar energy collector is available in various models, sizes and finish colors that make it easy to incorporate in contemporary design, traditional styles, and in retrofitting solar heating on existing buildings. *Solector* solar energy collectors are available in two lengths to accommodate various architectural constraints. Both liquid-type and air-type models are compatibly dimensioned and detailed so that they can be used side-by-side on the same building.

If the collectors are to be placed in a corrosive atmosphere, or if other than an aluminum mill finish is desired on the frame, anodized finishes can be specified at additional cost. If breakage of

the glass cover is a concern, such as from vandalism, the purchaser can cover the collectors with a layer of  $\frac{1}{2}$  in. hardware cloth after they have been installed, or Sunworks will substitute rigid plastic sheets at buyer's cost and risk.

**2. High Unit Efficiency.** The absorber of the *Solector* solar energy collector is coated with the Enthone® selective surface, an essential ingredient in a high performance collector. The low emissivity of the coating permits use of one cover sheet in areas that would otherwise require two cover sheets over non-selectively blackened absorber plates. The glass cover sheet has extremely high solar transmittance. The annual thermal efficiency of a Sunworks *Solector* solar energy collector with a single-glass-cover is between 25% and 50% higher than a non-selective double-glass-cover collector with a low transmissivity glazing and a flat black absorber.

The reasons for this difference are first, the lower reflective losses at higher solar incidence angles with one instead of two glass covers; second, high transmittance glazing (no iron content), further reduces reflective losses at high solar incidence angles over low transmissivity glazings (with iron content); third, the high heat retention properties of the selective surface. The annual thermal efficiency of a single-glass-cover *Solector* solar energy collector is superior to many collectors with two glass covers and a somewhat selective surface at temperature differences between absorber and ambient below 100°F.

Because of this combination of design features, the *Solector* solar energy collector is the most efficient collector available for medium temperature applications at comparable cost. This advantage alone is critically important in integrating solar collectors as part

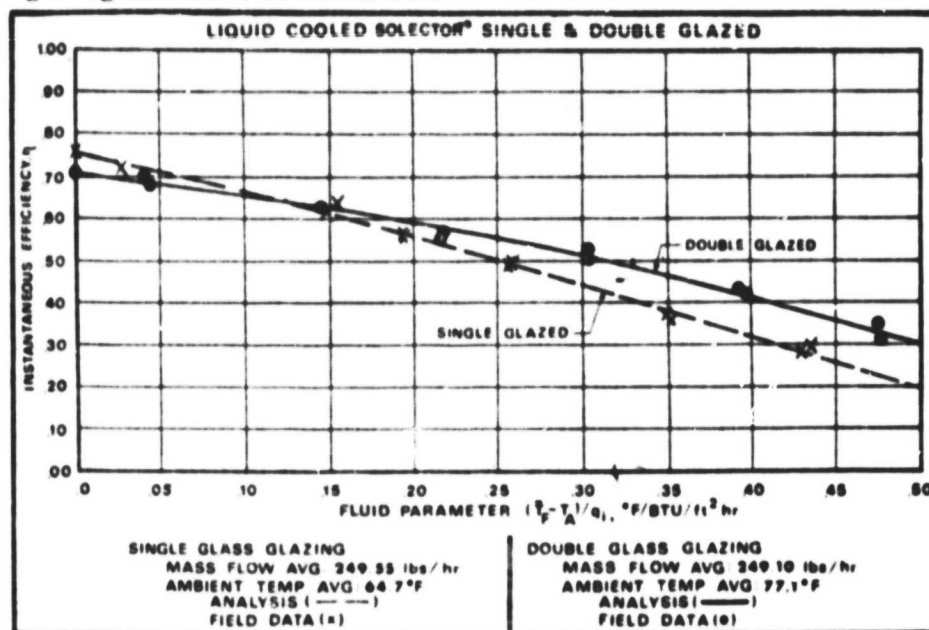
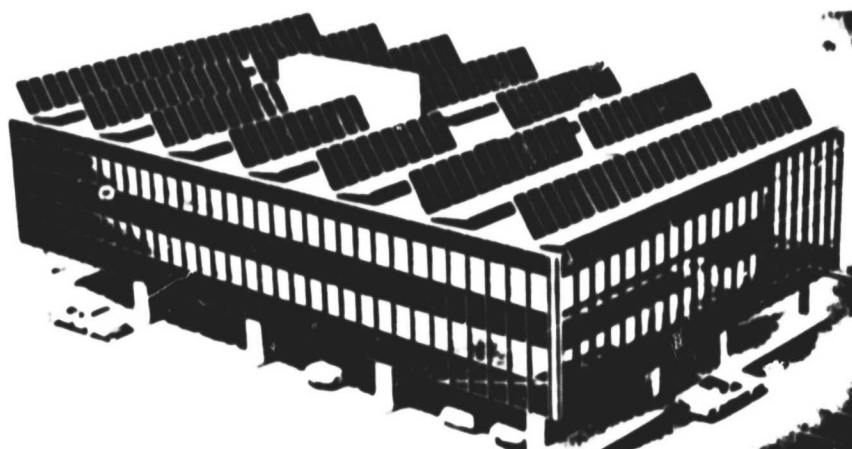


FIGURE 2.

Test conducted by Desert Sunshine Exposure Test, Inc., Phoenix, Ariz. March 1976. (raw data available upon request)

The instantaneous (slope-intercept method) thermal efficiency ( $\eta$ ) test is conducted by maintaining constant mass flow and varying the inlet temperature. The parameter used to plot along the abscissa is the average plate temperature minus the ambient temperature divided by the isolation falling on the aperture of the collector. The plot (curve) representing most collectors is not linear as suggested by the basic slope intercept method. Because the heat loss coefficient is temperature dependent, increasing with plate temperature, heat is lost to the ambient from the plate as a function of the difference in the fourth power of the absolute temperature. A higher or 2nd order polynomial is needed to plot a curve to fit the data. This plotting method has been employed in the above curves. The above curves (figure 2) have been generated in accordance to DSET spec. (75-SE2.2). This method generally meets or exceeds the procedure outlined by NBSIR 74-635.



Retro-fit, 171 Sunworks liquid selector enhanced by mirrors for commercial/office building, Stamford, CT.

Developer/Builder  
Mechanical Engineers  
Solar Design  
Project Coordinator

Lutz - Sotire Partnership  
J. O. Hess & Associates  
Wormser Scientific Corporation  
Copper Development Associates

of the building design both in terms of system capability and total installed cost. Less efficient collectors require larger collector areas and larger supporting roofs or structures, with resulting higher installation costs.

A similar procedure such as Figure (1) can be used to compare the cost effectiveness of other collectors. Collector performance figures should be based upon similar conditions such as those assumed in the example. Installation cost estimates should be adjusted

to reflect different mounting procedures, piping connections, etc.

Traditionally, collectors have been compared simply on a cost per square foot basis. When there was little difference between available collectors, this was a valid basis for comparison. But now, with the availability of high-performance collectors with long term reliability and durability, such as the Sunworks *Solector* solar energy collector, a different basis for cost comparison should be used. It makes little sense to

compare two collectors simply on a cost per square foot basis when collector "A" may deliver 25% more heat per month than collector "B". Further, it makes no sense to buy a low cost collector that has a short life expectancy, when the collector may fail before it can pay for itself in fuel savings. In essence, a buyer/specifier of solar collectors should be looking for equipment that delivers the maximum amount of heat per unit area, per dollar cost and exhibits long term reliability and durability. All objectives should be sought to insure the lowest life-cycle cost.

**3. Five Year Guarantee.** The most durable materials are used throughout the *Solector* solar energy collector. Under normal conditions, it may be expected to last well over 25 years. Even in no-flow conditions, the collector can withstand temperatures up to 400°F. without material or optical degradation. In the liquid collector, the copper tube to sheet connection is oven soldered over the entire length. All of the materials used in the *Solector* solar energy collector can be specified to meet the requirements of Class A fire zones. The standard *Solector* solar energy collector cover sheet is tempered glass, which is three to four times stronger than annealed glass of the same thickness. It can withstand wind loads up to 140 mph. Edges of the glass are swiped to further reduce the likelihood of breakage.

Factory assembly of the *Solector* solar energy collector assures an integrally joined unit that is soldered and brazed, pressure tested to 250 psi, cleaned, sealed and packaged as a complete module under rigid quality control standards. As a result, the Sunworks collector has one of the most thorough guarantees of any collector available.

The *Solector* solar energy collector carries a 5-year materials and workmanship guarantee (with the exception of cover glass breakage). The copper tubing inside the liquid collector is guaranteed against leaks for 5 years for most uses and transfer fluids. The selective surface is guaranteed to retain a minimum 80%

### DAY LONG THERMAL PERFORMANCE

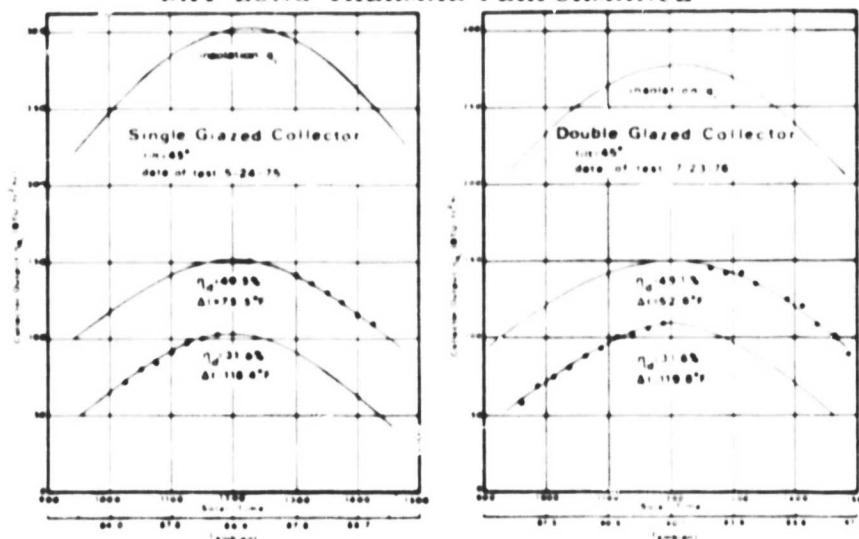


FIGURE 3.

Test conducted by Desert Sunshine Exposure Tests, Inc., Phoenix, Arizona, May/June 1976 (raw data available upon request). — All day thermal performance is determined by computing the efficiency ( $\eta$ ) as a function of time (solar day) while maintaining the mass flow rate and inlet temperature at constant values. The all day efficiency ( $\eta_D$ ) is found by integrating the curve to obtain heat removed by the transfer media from the total isolation received. DEST spec. (75-SE2.4).



or over, of initial optical efficiency for 5 years. A copy of the entire guarantee statement and conditions is available from your Sunworks representative.

4. **Easy Installation.** Much attention has been given to problems of weather tightness, condensation control, expansion, flashing, durability, and installation ease under actual construction conditions. In addition Sunworks collectors have been under continual field testing for over 3 years. The benefits of this experience have been incorporated into the design of the *Slector* solar energy collector.

The collector is light in weight and can be easily handled by two men. On the liquid cooled *Slector* a continuous mounting flange is integral with the frame across the top and bottom of the collector to facilitate installation. On the air cooled *Slector* preformed "U" clips join the keyways of adjoining *Selectors* as well as providing a tie down point for mounting. The extrusion forming the frame is a structural component which enables the collector to be anchored at both ends without further need to reinforce the unit to resist wind loads. *Slector* solar energy collectors are sized slightly smaller than the maximum dimensions given to eliminate the chance of progressive error in long rows. A keyway on the sides of the frame is provided to permit accurate alignment and interlocking of modules side-by-side where desired. A snap-in flashing reglet around the entire edge of the collector permits easy flashing for any roof or wall condition. Manifolds inside the liquid collector are pitched for rapid draining and elimination of air pockets upon filling. A weeping feature on all models allows the naturally induced condensation to drain from the collector. The absorber plate is free floating on a bed of insulation to allow for thermal expansion and contraction. This free floating absorber and its connections to external piping are thermally isolated from the rest of the collector.

All of these features unique to the *Slector* solar energy collector permit an efficient and reliable installation with low labor cost.



5. **Easy Servicing.** Little, if any, servicing should be required; but in the event that it is, the glass cover may be removed or replaced on the collector without disturbing the collector unit installation or flashing. In addition, each *Slector* solar energy collector module can be easily removed independent of adjacent modules.

6. **Testing.** Sunworks has incorporated in all of its product development and technical support comprehensive in-house and independent third-party testing programs. Sunworks has consistently lead the solar industry in promoting and contributing to the development of testing standards as well as publicly providing results of independent thermal performance and reliability/durability testing. In a continuing effort to improve and document the thermal performance and durability/reliability of the Sunworks Solar product line an ongoing testing program has become the foundation of Sunworks' research effort. The test data published in this bulletin as well as the most current data generated from the Sunworks testing program is available from your Sunworks representative.

7. **Piping Adaptability.** The 3' x 7' liquid *Slector*, solar energy collector (see page 6), is now also available with internal manifolding and side connections. This new piping scheme allows many *Selectors* to be coupled in parallel before returning to the main supply or return branch; resulting in less field connections and less piping accessories while still retaining a high installed net to gross ratio (approx. 88%). This new *Slector* configuration responds to the specific design requirements of commercial/institutional solar collector arrays, maximizing the amount of collectors able to be placed on to the structure while minimizing the installed cost. The optical and thermal properties as well as the physical design features of this new *Slector*, parallels those of the standard liquid cooled *Slector* with the exception of the collector to collector connections.

## Sunsol 60

Sunsol 60 is a non-toxic, non-flammable heat transfer media for liquid cooled solar collectors. It contains special corrosion inhibitors that will protect the life of copper and steel components within solar heating systems. Sunsol 60 contains a certified non-toxic dye for easy identification of leaks that may occur in the system.

Sunsol 60 can be used as is, undiluted. In its undiluted state it will resist freezing to temperatures of  $-55^{\circ}$  Fahrenheit. In areas where the most severe winter temperatures are higher, Sunsol 60 may be diluted with water.

## CALCULATED PRESSURE DROP

Calculated Pressure Drop vs Flow Rate  
Standard 3'0" x 7'0" Liquid *Slector*®

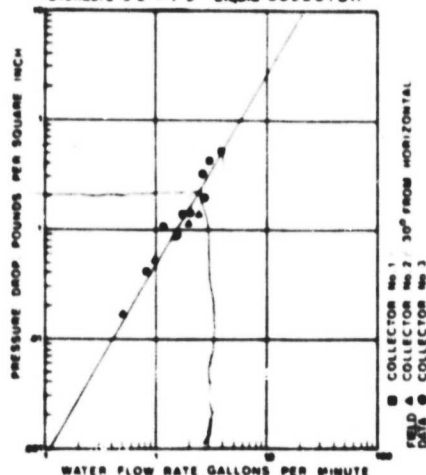


FIGURE 4

Calculated Pressure Drop vs Flow Rate  
Standard 3'0" x 7'0" Air *Slector*®

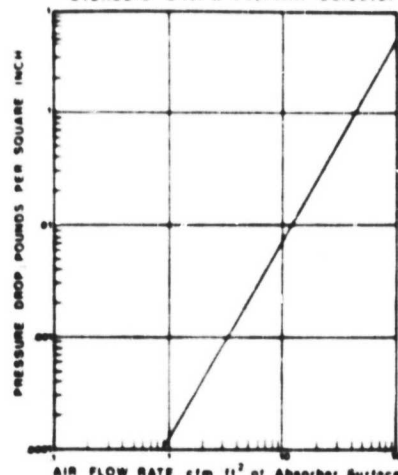
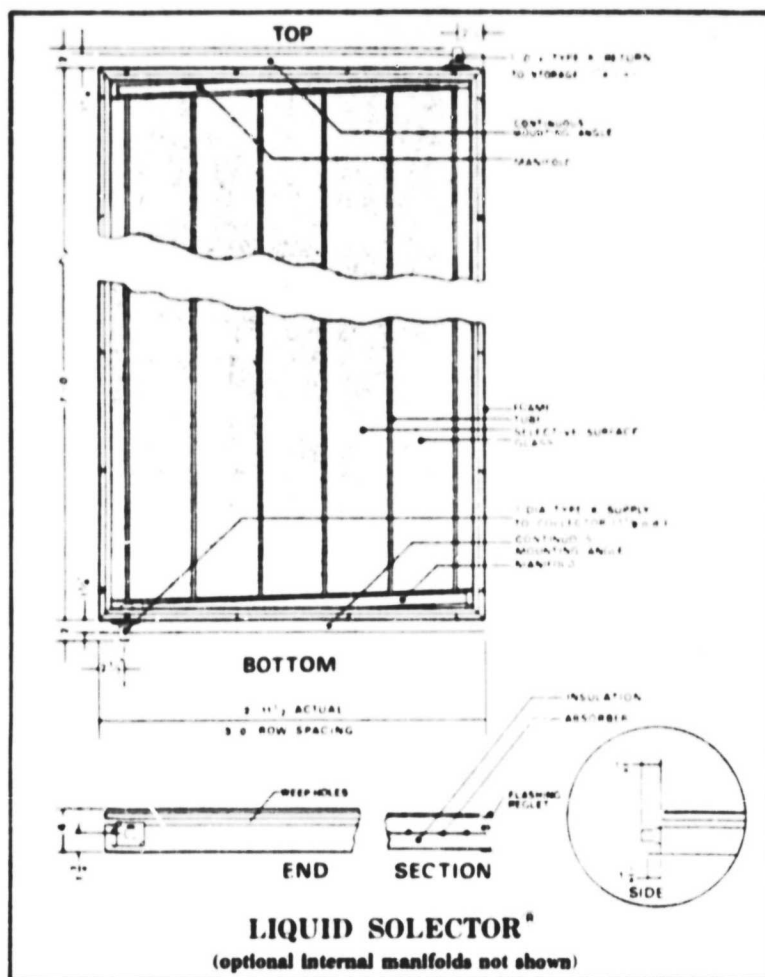


FIGURE 5



### Technical Data on Selector\* Solar Energy Collectors (liquid-cooled and air-cooled)\*

Cover: single glazing; no iron content,  $\frac{3}{8}$  in. tempered, edges swiped; double glazing; no iron content,  $2\frac{1}{8}$  in. tempered, edges swiped, sealed unit, total solar transmissivity of, single glazing = 92% - double glazing = 85%.

Absorber container: sides, aluminum extrusion; rear, aluminum sheet 0.05 in. thickness, pop rivet in place. Air space between cover and absorber: approximately  $\frac{3}{4}$  to 1 in.

Gasketing material: neoprene "U" gasket  
Weatherproofing: this module can be placed out in the weather without need for further weatherproofing

Finish on aluminum sides of container: standard mill finish. Anodized clear or black finish available at extra cost

Dimensions of surface-mounted module:

- outside dimensions overall:  $35\frac{1}{2}$  in. wide x 84 in. long x 4 in. thick (add  $1\frac{1}{4}$  in. each end for continuous mounting bracket liquid *Selector* only)
- effective absorber area = 18.68 ft<sup>2</sup>
- ratio of usable absorber area to total surface covered: 0.902
- glass area: 18.96 ft<sup>2</sup>

*Selector* solar energy collectors can be mounted end-to-end for series flow or side-by-side for parallel flow. It is recommended that no more than 3 collectors be connected in series. The *Selector* solar energy collector modules for both liquid and air are identical in size, 3 ft. wide and 4 in. thick and are available in two lengths, 5'4" long or 7'0" long.

### Liquid Data

#### Selector Solar Energy Collectors

#### Absorber:

- copper sheet: 0.010 in. thick (7 oz.)
- selective black: minimum absorptivity .87/.92 maximum emissivity .07/.35 manufactured by Enthone Inc., guaranteed durable to 400°F.
- copper tubes:  $\frac{1}{4}$  in. ID (0.375 in. OD)

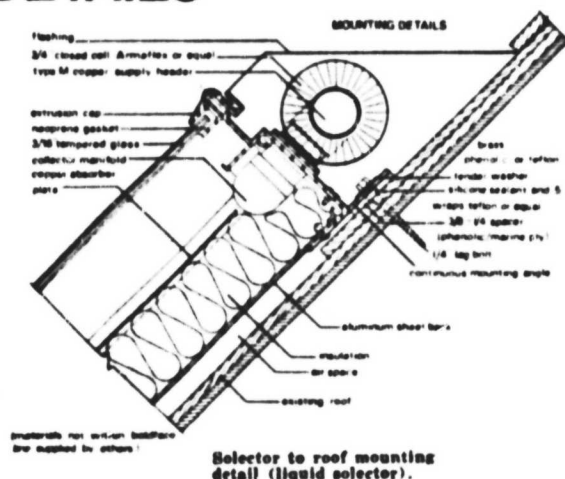
#### L-type

- tube spacing: 6 in. on center
- tube pattern: grid
- bond between tube and sheet: high temperature solder
- manifolds: 1 in. ID (1.125 in. OD)

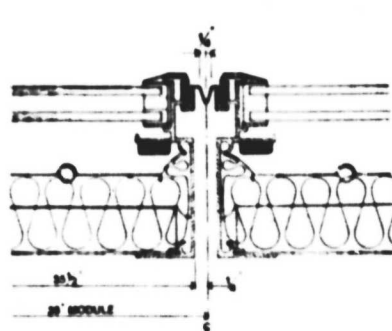
#### M-type copper

- tube connections to manifold: brazing alloy
- connection to external piping: 1 in. ID (1.125 in. OD) K-type copper, extending  $1\frac{7}{8}$  in. beyond collector ends; supply, top right; return, bottom left (when viewed

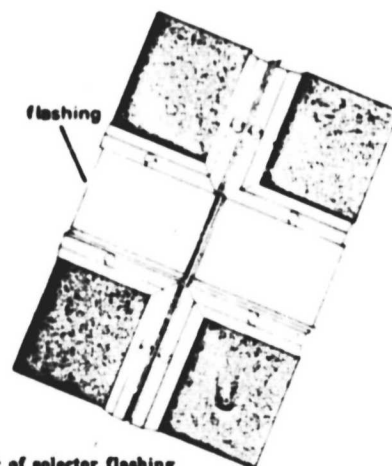
## DETAILS



Selector to roof mounting detail (liquid selector).



Selector flashing side to side detail.



Isometric of selector flashing at typical intersection.

from glazing side. See page 5, #7 for internal manifolding *Solector*).  
 -manifold/tubes pressure-tested to 15 atm; 125 psig working pressure  
 Insulation behind absorber: 2½ in. thick fiberglass, 1.5 lb/ft³ density, R = 10.0  
 Method of anchoring: continuous mounting bracket at each end of frame for anchoring; four predrilled holes are provided for anchor bolt or screw connections; additional holes may be drilled by installer if required.

Weight per module: 113.9 pounds, filled; 111 pounds, empty. Add 27 lbs. for double glazed unit. (NOTE: the liquid in the collector is equal to: 0.36 gallons or 46.4 ounces or 2.90 pounds or 0.05 ft³ or 80.5 in³.)

Recommended flow rate through collector: 14.7 #/ft²/hr (.55gpm) per collector (single glazed  $F_r = .90$ , double glazed  $F_r = .93$ ) (flow resistance at this rate is negligible. See figure 4).

Collector coolant: coolant should be Sunsol 60 made by Sunworks. In areas where regular tap water is used as a coolant, it is important that the pH be controlled between 6.5 and 8. These collectors can be used with other coolants but the user must contact the manufacturer for approval of specific liquids.  
 (See guarantee statement available from Sunworks representatives.)

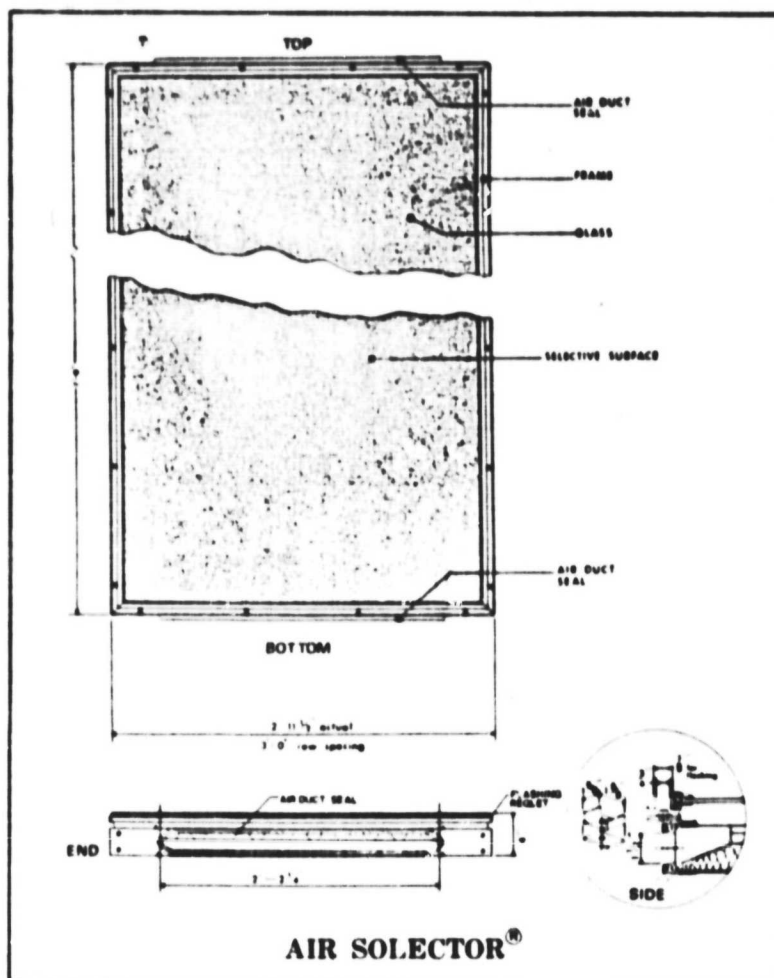
#### Air Data

#### Solector Solar Energy Collectors

##### Absorber:

- copper sheet: 0.016 in. thick (12 oz.)
- selective black: minimum absorptivity .87/.92 maximum emissivity .07/.35 manufactured by Enthone, Inc. durable to 400°F.
- air chamber: 7/8 in. high, thermal conductive epoxy bond to absorber
- connection to external duct: pressure seal/neoprene gasket
- distribution pattern: parallel top to bottom, under absorber

Insulation behind absorber: 1 in. thick



fiberglass plus 1 in. urethane: R = 10 Method of anchoring: prefabricated 'U' clip in key way at top and bottom of *Solector* bolt through 'U' clip to supporting structure.

Weight per module: 116 lbs. Add 27 lbs. for double glazing  
 Recommended flow rate through collector: 3cfm/ft² of collector (flow resistance at this rate is negligible. See figure 5).

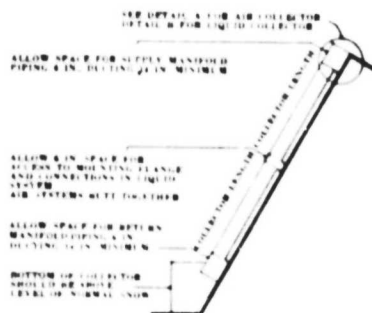
NOTE: Manufacturer reserves right to change specifications and dimensions without notice.

\*Trademark of Enthone, Inc.

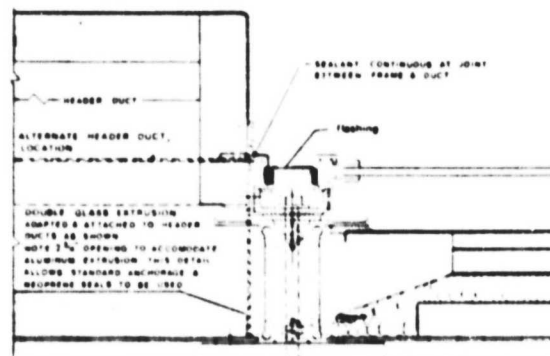
\*\*Patents Pending



Solector flashing  
top to bottom detail.



Solector spacing in series.



Solector to roof/duct mounting  
detail (air solelector).



SPECIALISTS IN SOLAR ENERGY EQUIPMENT  
P. O. Box 1004 • New Haven, CT 06508 • (203) 934-6301

## PERFORMANCE SPECIFICATIONS

The complete technical data for the Sunworks *Solector*® solar energy collectors are listed on pages 6 & 7. The collector also meets or exceeds the following performance specifications. Specifications unique to liquid flat-plate collectors are underlined. The specifications unique to the air flat-plate collectors are in [brackets.]

**General** — The collector shall be designed to absorb incoming solar radiation and transfer the resulting heat to a circulating fluid. The collector shall consist of — cover sheet(s), absorber plate coated with a selective surface, insulation and enclosure assembled in a manner to maintain thermal and mechanical performance over a minimum 25 year service life. The collector shall be guaranteed against leaks and against degradation of the selective surface for 5 years.

**Thermal Performance** — The instantaneous efficiencies of the collector shall be certified to be equal or better than those lying on a curve defined by the following six points (with  $Q_{inc} = 300\text{BTU/HR ft}^2$ ; all degrees measured in Fahrenheit):

|                        |                           | GLAZING          |        |
|------------------------|---------------------------|------------------|--------|
|                        |                           | SINGLE           | DOUBLE |
| $\Delta T = 20^\circ$  | $\Delta T/Q_{inc} = 0.07$ | Efficiency = 69% | 68%    |
| $\Delta T = 50^\circ$  | $\Delta T/Q_{inc} = 0.17$ | Efficiency = 58% | 61%    |
| $\Delta T = 100^\circ$ | $\Delta T/Q_{inc} = 0.33$ | Efficiency = 40% | 49%    |
| $\Delta T = 150^\circ$ | $\Delta T/Q_{inc} = 0.50$ | Efficiency = 20% | 31%    |
| $\Delta T = 200^\circ$ | $\Delta T/Q_{inc} = 0.67$ | Efficiency = —   | 11%    |

$$\Delta T = T_{in} - T_{out} - T_{amb}$$

**Mechanical Performance** — The collector unit must withstand conditions of extended radiation, humidity, condensation, temperatures under no-flow conditions up to 400°F., wind loads up to 140 mph, rain and snow. The collector unit must withstand expansion and contraction of the enclosure and of the connecting supply and return lines outside the collector. Penetrations of the extrusion for supply and return lines shall be gasketed so as to prevent air infiltration to the collector enclosure. All the materials used in the collector shall meet the requirements of Class — fire zones. Where multiple cover sheets are used, the spaces between covers shall be rigidly separated and sealed with U.V. protection. The absorber plate shall have a heat removal efficiency of .90 at 55 gpm per collector, using water as the heat transport fluid. Provision must be made for venting and draining of flow passages. The absorber shall have a grid flow pattern. The absorber sheet shall be continuously soldered to the tubing. The absorber shall be self-draining, and on filling, self venting. The tubing within the assembled collector shall be pressure tested by the manufacturer up to 250 lbs. psi. and shall have a working pressure in excess of 125 psi.

[The heat transfer core behind the absorber shall have a heat removal efficiency of 0.85 at 60 cfm per collector, using air as the heat transfer fluid. The heat transfer core shall be in intimate thermal contact with the absorber. The core shall be capable of withstanding an air pressure equal to one inch of water pressure without rupture.] The back insulation shall have an approximate "U" value equal to 0.11 BTU HR/ft<sup>2</sup>°F. The enclosure shall protect the assembly in normal shipment, installation, and service conditions. Penetration of supply and return tubing [ducting] through the collector shall be weather-tight. The cover sheet(s) shall be attached in a manner that permits servicing of an individual collector module by removing the cover sheet without removing the flashing or the entire module and without disassembling the entire array. Provision should be made for easily attaching flashing to the collector.

**SELECTIVE SURFACE**  
The Sunworks selective surface, developed by Enthone, Inc., is a non electrolytic conversion process yielding a thin film oxide. Enthone has developed a proprietary process in which the depth of oxidation is precisely controlled, resulting in a high solar absorptivity .87-.92 and a low thermal emissivity .05-.35. Sunworks division, Enthone, Inc. has further developed this process to assure the reliability and durability of this coating over extended periods of time under extreme environmental conditions. This selective coating and coating process is only available from Sunworks division, Enthone, Inc.

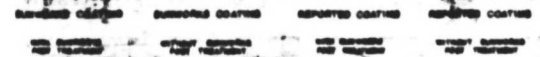
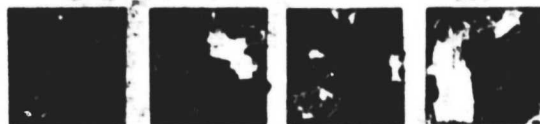
### SELECTIVE SURFACE DEGRADATION

600 HOURS AT 100°F WITH 100% REL. HUMIDITY



### SELECTIVE SURFACE DEGRADATION

600 HOURS AT 375°F



\*Trademark of Enthone Inc.  
Printed in U.S.A.



- A. solar hot water needs for family of three, Long Island, N.Y.
- B. — drain down system, C. Granbery FAIA, Architect, CT.
- C. — 26 air collectors for space heating, 4 liquid collectors for hot water, Long Island, N.Y. Residence
- D. — Army Corps of Engineers Experimental House Research Laboratory, Champaign, Ill.
- E. — Builder Dick Blasej, Grassy Brook Village, Vt.
- F. — 30,000 square ft. plant, Somerville, N.J.

ENTHONE, INCORPORATED

A subsidiary of ASARCO



SOLAR PIPING

glass  
fiber  
reinforced  
piping  
systems



ORIGINAL PAGE IS  
OF POOR QUALITY

# your best choice is a glass fiber reinforced pipe system

## lower installation cost

Every A.O. Smith-Inland piping system offers the tremendous advantage of *lighter weight*. Compared to most materials you may consider, this translates into easier and faster installation. In these days of ever-increasing labor prices, the savings in material handling and installation time offered by glass fiber reinforced pipe (FRP) must be considered a vital part of your piping system cost. As part of this, it is imperative that a complete selection of fittings be available for the pipe you choose. A.O. Smith-Inland has fittings for every type and size pipe.

## longer service life

The high corrosion resistance of reinforced plastic pipe makes it a logical choice over protected steels, black iron, copper and even stainless steel. Many years of experience have proven that the service life of glass fiber reinforced resin pipe will be greater than the traditional material. Select the right pipe for your application requirements and enjoy the resulting reduction in maintenance and replacement costs.



## light weight and full range of sizes

One of the primary advantages of A.O. Smith-Inland glass fiber reinforced pipe systems is their light weight in comparison to metal pipe. This light weight is of great value in reducing manpower and heavy equipment required in pipe installations, particularly in the larger diameters. A.O. Smith-Inland pipe systems are available in a full range of sizes ranging from 1" through 16" diameters as standard product lines, depending upon the pipe system chosen.

## choice of systems

A.O. Smith-Inland offers a wide range of superior piping systems (pipe and fittings) to match your requirements in both price and chemical resistance.

Choose from this outstanding family of reinforced glass fiber reinforced pipe.

**RED THREAD®** A glass fiber reinforced pipe with the proven ability to solve corrosion problems in moderate chemical service at temperatures to 180°F. RED THREAD pipe is available and stocked in diameters 2" through 12".

RED THREAD has been in field service since 1955. It has continuously proven its ability to withstand punishing service conditions.

**SILVER THREAD™** An epoxy resin pipe for moderate chemical service to 180°F. Available in 2" thru 12".

The newest addition to the line has a reinforced resin impregnated with a reinforcing material that provides effective shielding from damaging ultraviolet rays. The first pipe of its kind.

RED THREAD is especially good in outdoor service, field installations, and where the pipe is above the RED THREAD line.

**GREEN THREAD™** An epoxy resin pipe for moderate chemical resistance to 180°F. GREEN THREAD is available in 2" thru 12".

RED THREAD is a glass fiber reinforced pipe with a wall strength of 10,000 psi. It is resistant to acids, alkalis, and salts. It is also resistant to most organic solvents. It is available in 2" thru 12" diameters.

RED THREAD is a glass fiber reinforced pipe with a wall strength of 10,000 psi. It is resistant to acids, alkalis, and salts. It is also resistant to most organic solvents. It is available in 2" thru 12" diameters.

RED THREAD is a glass fiber reinforced pipe with a wall strength of 10,000 psi. It is resistant to acids, alkalis, and salts. It is also resistant to most organic solvents. It is available in 2" thru 12" diameters.

RED THREAD is a glass fiber reinforced pipe with a wall strength of 10,000 psi. It is resistant to acids, alkalis, and salts. It is also resistant to most organic solvents. It is available in 2" thru 12" diameters.

RED THREAD is a glass fiber reinforced pipe with a wall strength of 10,000 psi. It is resistant to acids, alkalis, and salts. It is also resistant to most organic solvents. It is available in 2" thru 12" diameters.

RED THREAD is a glass fiber reinforced pipe with a wall strength of 10,000 psi. It is resistant to acids, alkalis, and salts. It is also resistant to most organic solvents. It is available in 2" thru 12" diameters.



BELL AND SPIGOT



REDI-THREAD

## choice of joining methods

A.O. Smith-Inland offers a choice of proven joining methods. Each has distinct advantages in a given application and you can select the method most suitable to your installation requirements.

**Bell and Spigot** This is the primary method used for joining A.O. Smith-Inland systems and is the result of extensive research and development. This joint has been proven by years of field installation in all types of service. In this system, the pipe is supplied with one end tapered and the other end belled to accept a taper. The joint is secured with an adhesive designed to complement the operating conditions of the pipe system employed. The fittings are also manufactured to accept the tapered end of the pipe. The taper can be readily applied to the pipe in the field with a tool specifically made for the purpose.

The precise taper system insures those requirements necessary for a strong joint... uniform adhesive distribution, thin bond line and natural locking action. The latter is of additional benefit in installation, as the locking effect of the taper maintains the joint in position while the adhesive cures, allowing the work to proceed.

# from A.O. Smith-Inland Inc.

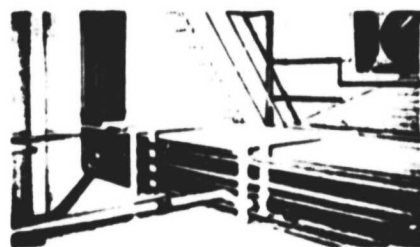
**REDI-THRED®** The REDI-THRED joint system is designed for rapid assembly of long runs of pipe. Each 30' length of 2", 3" or 4" RED THREAD is supplied with the REDI-THRED coupling factory installed.

The REDI-THRED couplings require no adhesive. Joints are completed in seconds without turning the entire pipe . . . just the threaded collar. Ideal for wet or cold weather use, and for temporary or permanent lines.

**Threaded High-Pressure** A.O. Smith-Inland also manufactures high pressure systems which are joined with an EUE 8-round thread. This method provides rapid installation and positive make-up for long-term performance. This system is primarily designed for oilfield applications but is suitable wherever pressure requirements of up to 2000 psi exist.



Twelve 3" RED THREAD flow lines in a typical oilfield installation. Lines are tied directly into header.

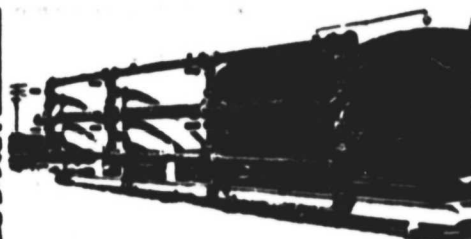


A RED THREAD installation in a chemical plant handling latex. The smooth, glossy interior surfaces resist build-up and do not contaminate the latex with metallic ions, a problem in the metallic lines previously used.

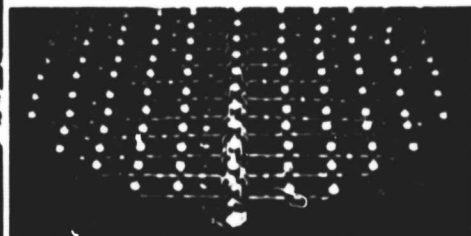
## A.O. Smith-Inland pipe and fittings serve a wide variety of applications

**RED THREAD** pipe and fittings are used extensively in petroleum production, in light duty chemical and industrial applications, in water and air lines, food processing plants . . . wherever light weight and moderate corrosion resistance are important factors.

**SILVER THREAD**, the newest A.O. Smith-Inland piping system, offers the same good resistance as RED THREAD in light duty chemical service, hard brines, air lines, etc. The ability to handle higher temperatures makes SILVER THREAD ideal for chill and hot water lines in commercial heating and air conditioning.



GREEN THREAD pipe and fittings on a custom-made filter for chemical processing.



GREEN THREAD was exclusively used in this complex internal filter grid for the same filter system. The solution being handled is a dilute sulfuric acid.



Unique self-contained water purification unit extensively utilizes A.O. Smith-Inland glass fiber reinforced epoxy pipe and fittings. Preamsembled piping network and controls eliminate high field erection costs. Units are frequently used in low temperature and corrosive atmospheres.

**GREEN THREAD** has good chemical resistance to the more aggressive chemicals at temperatures up to 225°F. It is used in process piping, condensate return lines, filtering systems, dilute acid lines and other similar applications.

**POLY THREAD** combines the best features of epoxy and polyester resins in a vinyl ester and glass fiber combination for unusual strength, flexibility, and resistance to acid, chlorine and bleach. Bell and spigot joining, plus a complete line of flanged bell end fittings, make POLY THREAD a highly versatile piping system.

A.O. Smith-Inland piping systems are finding ever-increasing varieties of applications because of their light weight, strength, corrosion resistance, and cost. Our customers include:

- Pulp and Paper Plants
- Chemical Processing Industries
- Food and Beverage Manufacturers
- Mining Industries
- Oilfields
- Refineries
- Steel Mills
- Fertilizer Manufacturers
- Industrial Plants
- Power Plants
- Chlorine-Caustic Plants
- Commercial Air Conditioning
- Municipal Aquariums
- Gasoline Service Stations
- Gas Distribution Companies



Extensive GREEN THREAD application in a copper mining installation. GREEN THREAD pipe and fittings in this installation handle a 2% to 5% sulfuric acid solution at 180° to 200°F temperatures. This installation illustrates the suitability of reinforced plastics in complex piping assemblies.

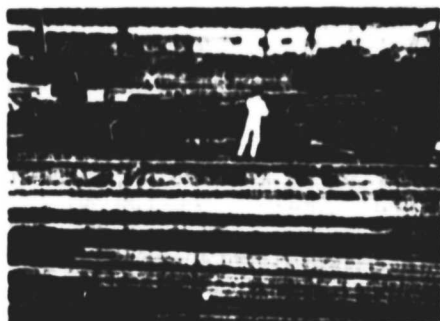


This POLY THREAD installation in a steel mill provides acid waste unloading lines from pickling tanks. Lines handle hydrochloric, sulfuric and 5% chromic acids at continuous 180°F. with surges to 200°F.

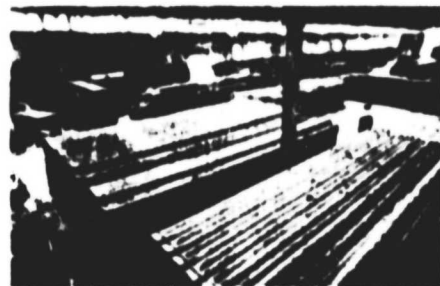
# modern research and production facilities

Ultra modern plant of 193,000 sq. ft. is devoted exclusively to the manufacture of glass fiber reinforced epoxy and vinyl ester pipe and fittings.

This building complex located in Little Rock, Arkansas, includes our home administration and sales office — plus our own expertly staffed research and development center.



Extensive testing conducted on all pipe production runs assures uniform high quality field operation. This is a hydrostatic mill pressure test in the A.O. Smith Inland plant, and is just one of the many quality control tests utilized to insure that the products reach the high standards that have been established.



Large finished stocks of all types and sizes of pipe are maintained on the spacious floor area of the Little Rock manufacturing facility. All are available through a wide network of A.O. Smith-Inland distributors.



Uniform, accurate fittings are produced on specially designed molding presses. You can select a complete piping system with assurance of the easiest and fastest installation at the most economical cost — using the same material throughout.



Fittings of all types, in every shape and size are available for each type of A.O. Smith-Inland pipe. This is a portion of the huge fittings inventory at Little Rock. All fittings offer the same reliability as the pipe — for pressure, temperature, and chemical resistance.

DISTRIBUTED BY



**A.O. SMITH-INLAND INC.**  
REINFORCED PLASTICS DIVISION

2700 WEST 65th STREET • LITTLE ROCK, ARKANSAS 72209

ORIGINAL PAGE IS  
OF POOR QUALITY





# A. O. SMITH-INLAND INC. REINFORCED PLASTICS DIVISION

Price  
Schedule  
Aug. 15, 1976

2700 W. 65TH STREET / LITTLE ROCK, ARKANSAS 72209  
AREA CODE 501 568-4010

## RED THREAD, SILVER THREAD, GREEN THREAD, and POLY THREAD FITTINGS

This price list covers the fittings for use with RED THREAD®, SILVER THREAD®, GREEN THREAD®, and POLY THREAD® piping.

Because of standardization, **SILVER THREAD** fittings can be used with either RED THREAD or SILVER THREAD and most 2" through 6" SILVER THREAD fittings are suitable for use with new dimension GREEN THREAD pipe. All fittings marked with a (†) will be SILVER THREAD instead of GREEN THREAD. Do not use any other SILVER THREAD fittings on GREEN THREAD pipe.

The GREEN THREAD fittings which are available can be used only with GREEN THREAD pipe and POLY THREAD fittings can be used only with POLY THREAD pipe. Only a limited number of RED THREAD fittings are available and are specified where applicable.

1" and 1 1/2" fittings are available in GREEN THREAD only; 14" and 16" fittings are available in POLY THREAD only.

### 90° and 45° ELBOWS – Bell or Flanged Ends<sup>(1)</sup> SILVER THREAD – GREEN THREAD – POLY THREAD

| Size   | Bx B     | Bx F     | Fx F     |
|--------|----------|----------|----------|
| 1"     | \$ 10.00 | \$ 20.00 | \$ 26.00 |
| 1 1/2" | 11.00    | 24.00    | 32.00    |
| 2"     | 12.25†   | 27.60†   | 39.60†   |
| 3"     | 16.25†   | 34.20†   | 48.50†   |
| 4"     | 20.10†   | 45.00†   | 60.00†   |
| 6"     | 55.00†   | 92.00†   | 100.00†  |
| 8"     | 98.00    | 125.00   | 150.00   |
| 10"    | 115.00   | 150.00   | 190.00   |
| 12"    | 132.00   | 180.00   | 235.00   |
| 14"    | 200.00   | 300.00   | 400.00   |
| 16"    | 230.00   | 340.00   | 450.00   |

### FLANGES and BLIND FLANGES SILVER THREAD – GREEN THREAD – POLY THREAD

| Size   | Flanges | Blind Flanges |
|--------|---------|---------------|
| 1"     | \$ 5.80 | \$ 9.25       |
| 1 1/2" | 6.20    | 9.50          |
| 2"     | 6.80†   | 9.00†         |
| 3"     | 9.00†   | 12.25†        |
| 4"     | 12.75†  | 14.50†        |
| 6"     | 25.25†  | 27.00†        |
| 8"     | 39.00   | 41.00         |
| 10"    | 48.00   | 69.00         |
| 12"    | 60.00   | 90.00         |
| 14"    | 120.00  | 180.00        |
| 16"    | 145.00  | 216.00        |

### TEES – Bell or Flanged Ends<sup>(1)</sup> SILVER THREAD – GREEN THREAD – POLY THREAD

| Size   | 3B       | 2B 1F    | 1B 2F    | 3F       |
|--------|----------|----------|----------|----------|
| 1"     | \$ 11.00 | \$ 22.00 | \$ 27.00 | \$ 32.00 |
| 1 1/2" | 14.00    | 25.00    | 33.00    | 42.00    |
| 2"     | 17.60†   | 29.75†   | 43.45†   | 53.35†   |
| 3"     | 19.00†   | 39.00†   | 54.75†   | 67.35†   |
| 4"     | 25.00†   | 50.25†   | 72.50†   | 82.75†   |
| 6"     | 72.00†   | 104.00†  | 116.00†  | 127.00†  |
| 8"     | 120.00   | 155.00   | 175.00   | 190.00   |
| 10"    | 170.00   | 200.00   | 240.00   | 275.00   |
| 12"    | 210.00   | 250.00   | 285.00   | 330.00   |
| 14"    | 275.00   | 400.00   | 575.00   | 675.00   |
| 16"    | 325.00   | 475.00   | 625.00   | 785.00   |

### SLEEVE COUPLINGS, THREADED ADAPTERS and GROOVED ADAPTERS<sup>(2)</sup> RED THREAD – SILVER THREAD – GREEN THREAD – POLY THREAD

| Size   | Sleeve Couplings | * Grooved and Threaded Adapters |
|--------|------------------|---------------------------------|
| 1"     | \$ 2.95          | \$ 4.50                         |
| 1 1/2" | 3.15             | 5.00                            |
| 2"     | 3.50             | 5.10                            |
| 3"     | 5.10             | 6.85                            |
| 4"     | 7.10             | 10.55                           |
| 6"     | 17.00            | 23.10                           |
| 8"     | 28.00            | 32.00                           |
| 10"    | 42.40            | -                               |
| 12"    | 57.00            | -                               |
| 14"    | 59.00            | -                               |
| 16"    | 65.00            | -                               |

\* These fittings are not available in POLY THREAD.

### NIPPLES – Tapered Both Ends RED THREAD – SILVER THREAD

| Size | 4"     | 6"                  | 8"     | 10"    | 12"     | 24"     | 36"     |
|------|--------|---------------------|--------|--------|---------|---------|---------|
| 2"   | \$1.23 | \$1.58              | \$1.94 | \$2.23 | \$ 2.56 |         |         |
| 3"   |        | 2.13 <sup>(3)</sup> | 2.61   | 3.04   | 3.80    |         |         |
| 4"   |        | 2.54                | 3.26   | 3.84   | 4.40    |         |         |
| 6"   |        | 3.42 <sup>(3)</sup> | 4.45   | 5.61   | 6.84    |         |         |
| 8"   |        |                     |        |        | 13.00   | \$24.00 |         |
| 10"  |        |                     |        |        |         | 41.00   | \$55.00 |
| 12"  |        |                     |        |        |         | 54.00   | 68.00   |

### NIPPLES – Tapered Both Ends GREEN THREAD – POLY THREAD

| Size   | 6"                  | 8"     | 12"     | 16"     |
|--------|---------------------|--------|---------|---------|
| 1"     | \$2.10              | \$2.60 |         |         |
| 1 1/2" | 2.25                | 2.75   |         |         |
| 2"     | 2.40                | 2.90   |         |         |
| 3"     | 3.10                | 3.75   |         |         |
| 4"     | 3.80 <sup>(4)</sup> | 4.40   |         |         |
| 6"     | 4.90 <sup>(4)</sup> | 7.50   | \$12.50 | \$16.00 |
| 8"     |                     |        | 17.00   | 19.15   |
| 10"    |                     |        | 25.00   | 28.00   |
| 12"    |                     |        | 40.00   | 49.00   |
| 14"    |                     |        | 55.00   | 62.50   |
| 16"    |                     |        | 70.00   | 80.00   |

\* Registered Trademark of A. O. Smith Inland Inc.

(1) B bell end, F flanged end.

(2) Grooved adapters available in spigot x groove or bell x groove. Threaded adapters available in bell x male NPT, bell x female NPT, spigot x male NPT, and spigot x female NPT.

(3) Actual length is 6 1/4".

(4) Actual length of Poly Thread nipple is 6 3/8".





# A. O. SMITH-INLAND INC. REINFORCED PLASTICS DIVISION

Price  
Schedule  
Aug. 15, 1976

2700 W. 65TH STREET / LITTLE ROCK, ARKANSAS 72209  
AREA CODE 501 568-4010

## RED THREAD,® SILVER THREAD,® GREEN THREAD,® and POLY THREAD® FITTINGS

### 45° LATERALS Bell or Flanged Ends(1) SILVER THREAD - GREEN THREAD - POLY THREAD

| Size | 3B       | 3F       |
|------|----------|----------|
| 1"   | \$ 23.00 | \$ 42.00 |
| 1½"  | 24.50    | 46.00    |
| 2"   | 30.00    | 62.50†   |
| 3"   | 40.00    | 80.00†   |
| 4"   | 50.00    | 100.00†  |
| 6"   | 112.00   | 160.00†  |
| 8"   | 150.00   | 235.00   |
| 10"  | 180.00   | 400.00   |
| 12"  | 220.00   | 500.00   |
| 14"  | 380.00   | 800.00   |
| 16"  | 450.00   | 900.00   |

### CROSSES Bell or Flanged Ends(1) SILVER THREAD - GREEN THREAD - POLY THREAD

| Size | 4B       | 4F       |
|------|----------|----------|
| 1"   | \$ 23.00 | \$ 50.00 |
| 1½"  | 26.00    | 62.50    |
| 2"   | 30.00†   | 75.00†   |
| 3"   | 36.00†   | 92.50†   |
| 4"   | 42.00†   | 118.50†  |
| 6"   | 140.00†  | 185.00†  |
| 8"   | 190.00   | 270.00   |
| 10"  | 250.00   | 450.00   |
| 12"  | 310.00   | 560.00   |
| 14"  | 500.00   | 1000.00  |
| 16"  | 600.00   | 1200.00  |

### CONCENTRIC REDUCERS - Bell or Flanged Ends(1) and REDUCER BUSHINGS SILVER THREAD - GREEN THREAD - POLY THREAD

| Size      | Concentric Reducers | Reducer Bushings |
|-----------|---------------------|------------------|
| 1" x ½"   | \$ -                | \$ 5.00          |
| 1½" x 1"  | -                   | 5.00             |
| 2" x 1½"  | 29.35               | 6.50†            |
| 3" x 2"   | 34.20†              | 6.25†            |
| 4" x 3"   | 41.00†              | 7.40†            |
| 6" x 4"   | 57.75†              | 12.15†           |
| 8" x 6"   | 73.00               | 22.75            |
| 10" x 8"  | 105.00              | 55.00            |
| 12" x 10" | 140.00              | 70.00            |
| 14" x 12" | 155.00              | 75.00            |
| 16" x 14" | 170.00              | 78.00            |

### REDUCING SADDLES - Bolted Side Outlet(4) SILVER THREAD - GREEN THREAD - POLY THREAD

| Size | 1"       | 1½"      | 2"       | 3"       | 4"      | 6"      | 8"       | 10"      | 12"      | 14"      |
|------|----------|----------|----------|----------|---------|---------|----------|----------|----------|----------|
| 2"   | \$12.00† | \$12.00† |          |          |         |         |          |          |          |          |
| 3"   | 12.00†   | 12.00†   | \$16.00† |          |         |         |          |          |          |          |
| 4"   | 12.00†   | 12.00†   | 16.00†   | \$22.00† |         |         |          |          |          |          |
| 6"   | 13.00†   | 13.00†   | 17.00†   | 23.00†   | +23.00† |         |          |          |          |          |
| 8"   | 13.00    | 13.00    | 17.00    | 23.00    | 23.00   | \$45.00 |          |          |          |          |
| 10"  | 13.00    | 13.00    | 17.00    | 23.00    | 32.00   | 45.00   | \$ 90.00 |          |          |          |
| 12"  | 13.00    | 13.00    | 23.00    | 23.00    | 32.00   | 45.00   | 90.00    | \$110.00 |          |          |
| 14"  |          |          | 27.00    | 30.00    | 36.00   | 55.00   | 100.00   | 130.00   | \$150.00 |          |
| 16"  |          |          | 27.00    | 30.00    | 36.00   | 55.00   | 100.00   | 130.00   | 150.00   | \$160.00 |

### END CAPS(6) SILVER THREAD - GREEN THREAD - POLY THREAD

| Size | \$      |
|------|---------|
| 2"   | \$6.15† |

### STIFFENERS and REDI-THRED® COUPLINGS RED THREAD Only

| Size | Coupling | Stiffener |
|------|----------|-----------|
| 2"   | \$14.25  | \$2.50    |
| 3"   | 18.00    | 4.25      |
| 4"   | 24.00    | 5.25      |
| 6"   |          | 6.75      |

### REDI-HEAT® PACK

| Size |        |
|------|--------|
| 2"   | \$ .85 |
| 3"   | .95    |
| 4"   | 1.05   |
| 6"   | 1.35   |

### ADHESIVE KITS(6)

|                                      |                    |         |
|--------------------------------------|--------------------|---------|
| DS-7014 (25 min. pot life)           | 6.8 oz.            | \$ 6.00 |
| DS-7024 (25 min. pot life)           | 2.50 oz. twin pack | 8.25    |
| DS-7054 (25 min. pot life)           | 1.6 oz. small pack | 2.50    |
| DS-7069 (25 min. pot life)           | 9.95 oz.           | 7.75    |
| DS-7125 (20 min. pot life)           | 6.8 oz.            | 6.25    |
| DS-8014 (15 min. pot life)           | 6.35 oz.           | 6.25    |
| DS-8024 (15 min. pot life)           | 2.66 oz. twin pack | 8.25    |
| DS-8055 (15 min. pot life)           | 1.3 oz. small pack | 2.50    |
| DS-8069 (15 min. pot life)           | 9.22 oz.           | 6.00    |
| DS-9014 (20 min. pot life)           | 6.34 oz.           | 6.50    |
| DS-9024 (20 min. pot life)           | 3.1 oz. twin pack  | 8.50    |
| DS-9069 (20 min. pot life)           | 14.44 oz.          | 8.00    |
| DS-8088 (Maintenance and Repair Kit) |                    | 13.50   |

MINIMUM ORDER - Total quantity \$50.00.

TERMS - F.O.B. origin. Prices subject to change without notice. Subject to conditions of sale as printed on reverse side of pipe price schedules.

(1) B-bell end, F flanged end. (3) 2" x 1", 2" x 1½" reducer bushings with NPT female threads available. (4) 2", 3", 4" & 6" saddles are available with 1", 1½" or 1¾" NPT threaded side outlets. (5) End caps in other sizes available on special quotation. (6) Consult Bulletin A100-1 to determine proper adhesive usage.

© Registered Trademarks of A.O. Smith-Inland Inc.

**TABLE I.1**  
**ULTIMATE AND ALLOWABLE DESIGN STRESSES AND OTHER PHYSICAL PROPERTIES**

| PROPERTY                                       | TEST METHOD | RED THREAD                     |                        | SILVER THREAD                  |                        | GREEN THREAD                   |                        |
|--|-------------|--------------------------------|------------------------|--------------------------------|------------------------|--------------------------------|------------------------|
|  |             | 75°F                           | 150°F                  | 75°F                           | 210°F                  | 75°F                           | 225°F                  |
| <b>Axial Tensile</b>                           |             |                                |                        |                                |                        |                                |                        |
| Ultimate Stress                                | ASTM D2105  | 9,100 psi                      | 8,320 psi              | 10,300 psi                     | 6,100 psi              | 9,740 psi                      | 5,110 psi              |
| Design Stress                                  |             | 2,275 psi                      | 2,080 psi              | 2,575 psi                      | 1,525 psi              | 2,435 psi                      | 1,280 psi              |
| Modulus of Elasticity                          | ASTM D2105  | $1.15 \times 10^6$ psi         | $1.0 \times 10^6$ psi  | $1.4 \times 10^6$ psi          | $0.8 \times 10^6$ psi  | $1.07 \times 10^6$ psi         | $0.57 \times 10^6$ psi |
| <b>Axial Compression</b>                       |             |                                |                        |                                |                        |                                |                        |
| Ultimate Stress                                | ASTM D695   | 13,500 psi                     | 11,800 psi             | 17,800 psi                     | 11,300 psi             | 30,300 psi                     | 17,200 psi             |
| Design Stress                                  |             | 3,375 psi                      | 2,950 psi              | 4,450 psi                      | 2,925 psi              | 7,575 psi                      | 4,300 psi              |
| Modulus of Elasticity                          |             | $1.01 \times 10^6$ psi         | $0.67 \times 10^6$ psi | $0.85 \times 10^6$ psi         | $0.83 \times 10^6$ psi | $1.49 \times 10^6$ psi         | $1.25 \times 10^6$ psi |
| <b>Beam Bending</b>                            |             |                                |                        |                                |                        |                                |                        |
| Ultimate Stress                                | AOS-I TM    | 18,300 psi                     | 11,900 psi             | 17,800 psi                     | 8,500 psi              | 22,000 psi                     | 10,600 psi             |
| Design Stress                                  |             | 2,000 psi                      | 1,500 psi              | 2,000 psi                      | 1,000 psi              | 2,000 psi                      | 1,250 psi              |
| <b>Hydrostatic Burst</b>                       |             |                                |                        |                                |                        |                                |                        |
| Ultimate Hoop Stress 2" - 6"                   | ASTM D1599  | 71,000 psi                     | 81,000 psi             | 63,000 psi                     | 66,000 psi             | -                              | -                      |
| Ultimate Hoop Stress 8" - 12"                  | ASTM D1599  | 40,000 psi                     | 40,000 psi             | 30,000 psi                     | 45,000 psi             | -                              | -                      |
| Ultimate Hoop Stress All Sizes                 | ASTM D1599  | -                              | -                      | -                              | -                      | 36,000 psi                     | 41,000 psi             |
| <b>Hydrostatic Design</b>                      | ASTM D2992  |                                |                        |                                |                        |                                |                        |
| Cyclic $150 \times 10^6$ Cycles                | Procedure A | 5,150 psi                      | 5,000 psi              | 6,800 psi                      | 4,500 psi              | 6,000 psi                      | 5,800 psi              |
| Static Basis $10^6$ hours                      | Procedure B | 15,300 psi                     | 15,300 psi             | (2)                            | (2)                    | (2)                            | (2)                    |
| Static Design (1) at $10^6$ hours              |             | 7,650 psi                      | 7,650 psi              | -                              | -                      | -                              | -                      |
| <b>Coefficient of Linear Thermal Expansion</b> |             |                                |                        |                                |                        |                                |                        |
| Sizes 2" thru 6"                               | AOS-I TM    | $1.35 \times 10^{-5}$ in/in/°F |                        | $1.22 \times 10^{-5}$ in/in/°F |                        | -----                          |                        |
| Sizes 8" thru 12"                              | AOS-I TM    | $0.88 \times 10^{-5}$ in/in/°F |                        | $0.88 \times 10^{-5}$ in/in/°F |                        | -----                          |                        |
| All Sizes                                      | AOS-I TM    | -----                          |                        | -----                          |                        | $1.14 \times 10^{-5}$ in/in/°F |                        |

| PROPERTY                                       | TEST METHOD | CHEMLINE                       |                        | POLY THREAD                    |                        |
|--|-------------|--------------------------------|------------------------|--------------------------------|------------------------|
|  |             | 75°F                           | 225°F                  | 75°F                           | 200°F                  |
| <b>Axial Tensile</b>                           |             |                                |                        |                                |                        |
| Ultimate Stress                                | ASTM D2105  | 6,550 psi                      | 6,000 psi              | 9,100 psi                      | 4,400 psi              |
| Design Stress                                  |             | 1,640 psi                      | 1,500 psi              | 2,275 psi                      | 1,100 psi              |
| Modulus of Elasticity                          | ASTM D2105  | $1.7 \times 10^6$ psi          | $1.04 \times 10^6$ psi | $1.4 \times 10^6$ psi          | $0.7 \times 10^6$ psi  |
| <b>Axial Compression</b>                       |             |                                |                        |                                |                        |
| Ultimate Stress                                | ASTM D695   | 34,400 psi                     | 21,400 psi             | 16,700 psi                     | 16,300 psi             |
| Design Stress                                  |             | 8,600 psi                      | 5,350 psi              | 4,175 psi                      | 4,075 psi              |
| Modulus of Elasticity                          |             | $2.12 \times 10^6$ psi         | $1.33 \times 10^6$ psi | $1.39 \times 10^6$ psi         | $0.74 \times 10^6$ psi |
| <b>Beam Bending</b>                            |             |                                |                        |                                |                        |
| Ultimate Stress                                | AOS-I TM    | 22,300 psi                     | 13,000 psi             | 21,500 psi                     | 9,300 psi              |
| Design Stress                                  |             | 2,000 psi                      | 1,500 psi              | 2,000 psi                      | 1,000 psi              |
| <b>Hydrostatic Burst</b>                       |             |                                |                        |                                |                        |
| Ultimate Hoop Stress All Sizes                 | ASTM D1599  | 21,625 psi                     | 21,625 psi             | 44,000 psi                     | 30,850 psi             |
| <b>Hydrostatic Design</b>                      | ASTM D2992  |                                |                        |                                |                        |
| Cyclic $150 \times 10^6$ Cycles                | Procedure A | 4,950 psi                      | 4,950 psi              | 4,400 psi                      | 3,200 psi              |
| Static Basis $10^6$ hours                      | Procedure B | (2)                            | (2)                    | (2)                            | (2)                    |
| Static Design (1) at $10^6$ hours              |             | -                              | -                      | -                              | -                      |
| <b>Coefficient of Linear Thermal Expansion</b> |             |                                |                        |                                |                        |
| Sizes 2" thru 6"                               | AOS-I TM    | -----                          |                        | -----                          |                        |
| Sizes 8" thru 12"                              | AOS-I TM    | -----                          |                        | -----                          |                        |
| All Sizes                                      | AOS-I TM    | $1.08 \times 10^{-5}$ in/in/°F |                        | $1.05 \times 10^{-5}$ in/in/°F |                        |

(1) Service Factor of 0.5 applied to static basis

(2) Data not available at time of printing

**TABLE 1.2**  
**PIPE DIMENSIONS, WEIGHTS, AND CAPACITY**

| TYPE                          | Size | Nominal<br>O.D.<br>(in.) | Nominal<br>I.D.<br>(in.) | Nominal<br>Total Wall<br>Thick-<br>ness<br>(in.) | Nominal<br>Reinforced<br>Wall<br>Thickness<br>(in.) | Nominal<br>Weight<br>(Lbs./Ft.) | Nominal<br>Capacity<br>(Gal./Ft.) (Cu.Ft./Ft.) |       |
|-------------------------------|------|--------------------------|--------------------------|--|---|---------------------------------|--|-------|
| <b>RED THREAD<br/>RTP-70</b>  | 2"   | 2.375                    | 2.235                    | .070   | .070  | 0.4                             | .20  | .0274 |
|                               | 3"   | 3.500                    | 3.360                    | .070   | .070  | 0.6                             | .47  | .0623 |
|                               | 4"   | 4.500                    | 4.360                    | .070   | .070  | 0.8                             | .78  | .1042 |
|                               | 6"   | 6.625                    | 6.405                    | .110   | .110  | 1.7                             | 1.67   | .2238 |
|                               | 8"   | 8.636                    | 8.352                    | .142   | .142  | 3.2                             | 2.85   | .3812 |
|                               | 10"  | 10.694                   | 10.350                   | .172   | .172  | 4.8                             | 4.37   | .584  |
|                               | 12"  | 12.680                   | 12.270                   | .205   | .205  | 6.0                             | 6.14   | .8207 |
| <b>RED THREAD<br/>RTP-190</b> | 2"   | 2.380                    | 2.000                    | .190   | .190  | 1.19                            | .16  | .0217 |
|                               | 2½"  | 2.821                    | 2.441                    | .190   | .190  | 1.32                            | .24  | .0325 |
| <b>SILVER THREAD</b>          | 2"   | 2.375                    | 2.235                    | .070   | .070  | 0.4                             | .20  | .0274 |
|                               | 3"   | 3.500                    | 3.360                    | .070   | .070  | 0.6                             | .47  | .0623 |
|                               | 4"   | 4.500                    | 4.360                    | .070   | .070  | 0.8                             | .78  | .1042 |
|                               | 6"   | 6.625                    | 6.405                    | .110   | .110  | 1.7                             | 1.67   | .2238 |
|                               | 8"   | 8.636                    | 8.352                    | .142   | .142  | 3.2                             | 2.85   | .3812 |
|                               | 10"  | 10.694                   | 10.350                   | .172   | .172  | 4.8                             | 4.37   | .584  |
|                               | 12"  | 12.680                   | 12.270                   | .205   | .205  | 6.0                             | 6.14   | .8207 |
| <b>GREEN THREAD</b>           | 1"   | 1.335                    | 1.191                    | .072   | .048  | 0.2                             | .06  | .0078 |
|                               | 1½"  | 1.920                    | 1.756                    | .082   | .058  | 0.4                             | .13  | .0169 |
|                               | 2"   | 2.375                    | 2.147                    | .114   | .090  | 0.6                             | .19  | .0251 |
|                               | 3"   | 3.500                    | 3.272                    | .114   | .090  | 0.9                             | .44  | .0584 |
|                               | 4"   | 4.500                    | 4.272                    | .114   | .090  | 1.2                             | .74  | .0995 |
|                               | 6"   | 6.625                    | 6.337                    | .144   | .120  | 2.4                             | 1.64   | .2190 |
|                               | 8"   | 8.676                    | 8.352                    | .162   | .138  | 3.4                             | 2.85   | .3812 |
|                               | 10"  | 10.734                   | 10.350                   | .192   | .168  | 5.0                             | 4.37   | .584  |
|                               | 12"  | 12.714                   | 12.270                   | .222   | .198  | 7.1                             | 6.14   | .8207 |
| <b>CHEMLINE</b>               | 2"   | 2.455                    | 2.235                    | .110   | .095  | 0.7                             | .20  | .0274 |
|                               | 3"   | 3.580                    | 3.360                    | .110   | .095  | 1.0                             | .47  | .0623 |
|                               | 4"   | 4.580                    | 4.360                    | .110   | .095  | 1.3                             | .78  | .1042 |
|                               | 6"   | 6.625                    | 6.295                    | .165   | .135  | 2.6                             | 1.62   | .2160 |
| <b>POLY THREAD</b>            | 2"   | 2.375                    | 2.135                    | .120   | .096  | 0.6                             | .19  | .0249 |
|                               | 3"   | 3.500                    | 3.260                    | .120   | .096  | 0.9                             | .43  | .0579 |
|                               | 4"   | 4.500                    | 4.260                    | .120   | .096  | 1.2                             | .74  | .0989 |
|                               | 6"   | 6.625                    | 6.295                    | .165   | .141  | 2.6                             | 1.62   | .2160 |
|                               | 8"   | 8.676                    | 8.364                    | .156   | .132  | 3.1                             | 2.85   | .3814 |
|                               | 10"  | 10.734                   | 10.382                   | .176   | .152  | 4.3                             | 4.40   | .5876 |
|                               | 12"  | 12.714                   | 12.304                   | .205   | .181  | 6.1                             | 6.17   | .8253 |
|                               | 14"  | 14.480                   | 14.000                   | .240   | .216  | 8.1                             | 7.99   | 1.068 |
|                               | 16"  | 16.540                   | 16.000                   | .270   | .246  | 10.5                            | 10.44  | 1.396 |

**NOTE:** All values are nominal values. Tolerances or maximum/minimum limits can be obtained from A. O. Smith-Inland Inc.

## SECTION 2 JOINING SYSTEMS

A. O. Smith-Inland offers a choice of proven joining methods. Each has distinct advantages in a given application and you can select the method most suitable to your installation requirements.

### A. PIPE AND FITTINGS CONNECTIONS

**BELL AND SPIGOT** — This is the primary method used for joining A. O. Smith-Inland systems and is the result of extensive research and development. This joint has been proven by years of field installation in all types of service. In this system, the pipe is supplied with one end tapered and the other end belled or fitted with a coupling to accept a taper. The joint is secured with an adhesive designed to complement the operating conditions of the pipe system employed. The fittings are also manufactured to accept the tapered end of the pipe. The taper can be readily applied to the pipe in the field with a tool specifically made for the purpose.

The precise taper system insures those requirements necessary for a strong joint — uniform adhesive distribution, thin bond line and natural locking action. The latter is of additional benefit in installation, as the locking effect of the taper maintains the joint in position while the adhesive cures, allowing the work to proceed.

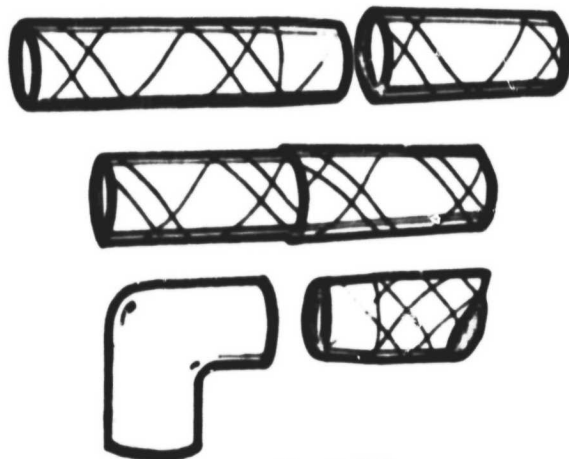


Figure 2.0  
Bell and Spigot

**THREADED AND BONDED (T.A.B.)™ JOINT** — Our exclusive Threaded and Bonded (T.A.B.) Joint on 2" through 6" RED THREAD and SILVER THREAD improves the reliability of an already reliable bell and spigot joint. It reduces the opportunity for installation errors under all temperature conditions.

This joining system combines both threads and adhesive on the bonding surfaces. Both bell and spigot ends of the pipe are threaded with our unique profile double-lead threads.

The mechanical locking action of these threads promotes positive make up which prevents backout during adhesive curing. In addition, the locking action permits some movement of the pipe before adhesive cure. It's especially helpful on installations over rough or uneven terrain or under low temperature conditions. And installation is still fast and easy; the threads lock with only a few turns of the pipe.

No need to carry a double inventory just to use our new joint system. When bonding our T.A.B. Joint to nonthreaded bell and spigots or fittings, the adhesive bond is as strong as a conventional joint.

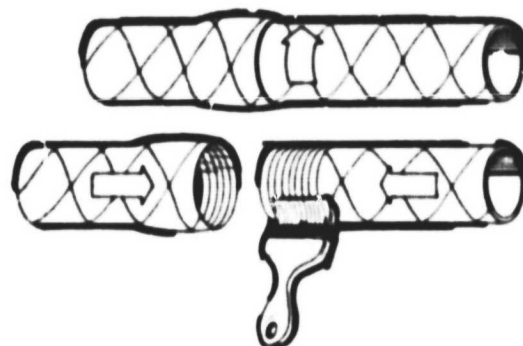


Figure 2.1  
T.A.B. Joint

**REDI-THRED®** — The REDI-THRED joint system is designed for rapid assembly of long runs of pipe. Each 30' length of 2", 3" or 4" RED THREAD is supplied with the REDI-THRED coupling factory installed.

The REDI-THRED couplings require no adhesive. Joints are completed in seconds without turning the entire pipe . . . just the threaded collar. Ideal for wet or cold weather use, and for temporary or permanent lines.



Figure 2.2  
REDI-THRED

## SECTION 4 SUPPORTS, ANCHORS, GUIDES

### ABOVE GROUND INSTALLATIONS

Above ground installations can be broadly divided into two categories — lines which are laid directly on the surface of the ground and those which are hung or supported as in a typical plant. In either case, there are certain basic guidelines to be followed:



Figure 4.0  
Excessive Bending

On any lines laid directly on the surface, care should be taken to insure that there are no excessive bends that would impose undue stress on the pipe, and that adequate protection is provided in areas where possible mechanical damage could occur. If the line is connected into a system which could impart a vibration or pulsing action to the pipe, areas of contact with supports should be protected to prevent the pipe from abrading as shown in Figure 4.1.



Figure 4.1  
Point Loading

**A. SUPPORTS:** Horizontal pipe should be supported at intervals suggested by the support spacing data in Figures 4.14 through 4.18. Supports that have point contact or narrow supporting areas should be avoided, and valves or other heavy equipment should be supported independently of the pipe. (Figures 4.2 and 4.3)

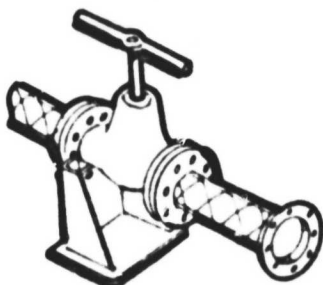
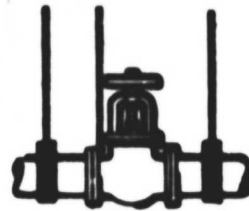


Figure 4.2  
Supports for Valves



Figure 4.3  
Supports for Valves



When possibility exists that valve will be removed periodically, pipe should be supported on both sides of valve.

Figure 4.4  
Removable Valve Supports

Standard sling, clamp and clevis hangers and shoe supports designed for use with steel pipe can be used to support A. O. Smith-Inland pipe. (Figures 4.5 through 4.10). Any other type of support that gives a wide band of contact with at least 120° of contact with the pipe can be used.

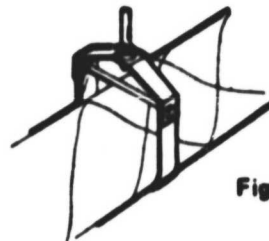


Figure 4.5



Figure 4.6



Figure 4.7



Figure 4.8



Figure 4.9



Figure 4.10

Figures 4.5 thru 4.10  
Hangers and Other Pipe Supports



## RED THREAD SPECIFICATION STATEMENT

### I. RAW MATERIALS

**Glass Fiber** — Continuous single end EK-37s with an epoxy compatible binder and epoxy compatible silane coupling agent. Each strand of EK-37s to be individually tensioned during pipe and fittings manufacture.

**Resin Formulation** — Stoichiometric ratio of bisphenol A — epichlorohydrin epoxy resins and any of the following aromatic amine curing agents:

Metaphenylene diamine  
Methylene dianiline  
Diamino diphenyl sulfone

### II. PROCESS

**Pipe Winding** — Pipe will be filament wound using the above raw materials with fiber glass oriented at helix angle of  $35\frac{1}{4}^\circ$  as measured from the vertical axis. The resin content shall be 28% by weight. The pipe shall be completely cured at an elevated temperature so that subsequent methylene chloride solvent extractables of less than 5% are obtained (pipe to be finely ground, solvent extracted at room temperature for one hour).

**In-Line Fittings** — These are to be filament wound at a helix angle of  $35\frac{1}{4}^\circ$  using individually tensioned, continuous single strands of EK-37s glass fiber and a liquid epoxy resin system mentioned above, cured

at an elevated temperature until methylene chloride extractables of less than 5% are obtained. Resin content shall be 28% minimum.

**Molded Fittings** — Compression molded using an epoxy molding compound with strength, thermal and chemical resistances at least as good as the pipe and in-line fittings. This molding compound reinforced with a minimum of 60% chopped glass fiber. The molded fittings cured at an elevated temperature until methylene chloride extractables of less than 5% are obtained.

### III. JOINING TECHNIQUES

The pipe and fittings will be able to be joined with an epoxy adhesive on matching tapered bell and spigot. The adhesive consisting of a compatible epoxy resin cured with an aliphatic amine. Material to be installed in accordance with AOS-I installation manual No. 9474.

### IV. PRESSURE RATING

The entire piping system (pipe, fittings and adhesive joints) shall be pressure rated using ASTM Test Method D-2992 titled, "Standard Method for Obtaining Hydrostatic Design Basis for Reinforced Thermosetting Resin Pipe and Fittings". Minimum continuous pressure rating — 150 psi to 150°F.

## SILVER THREAD GENERAL SPECIFICATIONS

### SCOPE

**Pipe** — Pipe shall be manufactured by A. O. Smith-Inland Inc. by the filament winding process using a thermosetting epoxy resin to impregnate strands of continuous glass filaments which are wound around a straight mandrel at a prescribed helix angle and under controlled tension. All pipe will be supplied with a matching tapered integral bell and tapered spigot or tapered coupling and a matching tapered spigot.

### WORKING LIMITS

Minimum continuous pressure rating 150 psi at 210°F in determined accordance with ASTM Standard Method of Test D2992 — Procedure A. Consult manufacturer's catalog for more detailed information.

### CONSTRUCTION

2" thru 12" — SILVER THREAD pipe shall have continuous glass fibers filament

wound at  $35\frac{1}{4}^\circ$  helix angle in a matrix of epoxy resin pigmented to resist ultraviolet degradation. Pipe shall be in compliance with ASTM Specification D2996-71 and classified by its designation code as shown in Table 11.1. Pipe shall meet all dimensional and performance requirements, mechanical properties, and shall be marked with the following designation codes.

TABLE 11.1

| SIZE     | DESIGNATION CODE AT 73.4°F |
|----------|----------------------------|
| 2" - 4"  | RTRP-11AE-4111             |
| 6"       | RTRP-11AE-4112             |
| 8" - 10" | RTRP-11AE-2112             |
| 12"      | RTRP-11AE-2114             |



ARKLA

ABSORPTION CHILLER

## General Description

Akita's Solar-300 water chiller is designed primarily for solar cooling applications, but can be used for a broad range of comfort conditioning and industrial process applications. With inlet water temperature between 160°F and 200°F and with 85°F condensing water, the machine can produce from 7.5 tons to 26.5 tons of cooling capacity.

## Features

- The unit is nominally rated at 25 tons, but design flexibility allows easy modification for a wide range of capacities.
- The special lubrication and water solution is installed at the factory and each machine is given a complete capacity test.
- The low concentration of lime scale in the water and low mineral content in the condensing water.
- The horizontal centrifugal pump is driven by a heavy-duty, torque transfer system with the pump on the side of the machine, thus eliminating the absorption of vibration.
- The condenser is a double coil, Y-tube design, which allows for easy access to the condenser for cleaning.

## Operating Controls

- **Three-Way Hot Water Control Valve**—The amount of hot water to the generator is controlled by the cooling load. With low cooling loads the hot water control valve is partially closed and a portion of the hot water is diverted back to the thermal storage tank or the solar collector system. When the cooling load drops to a point where hot water flow is minimal, the valve closes and an end switch will cause the unit to shut down.
- **Two Input Controller**—With two temperature sensing bolts, one for leaving chilled water and one for returning chilled water, this solid state device controls the operation of the three-way hot water control valve.
- **Solution By-Pass Valve and Timer**—On start-up, this valve opens, causing some hot water to bypass the condenser and return to the collector.
- **Concentration Chamber Dump Valve**—If the heat exchanger becomes fouled with mineral deposits, this valve can be used to dump the chamber and clean it.

## Safety Controls

- **Evaporator Low Temperature Switch**—If the refrigerant in the flash chamber falls below minimum temperatures, this safety switch will cause the hot water control valve to close and divert all the hot water around the generator. It will also shut down both the solution pump and the condensing water.
- **Chilled Water Low Temperature Switch**—The safety switch performs the same function as the evaporator low temperature switch but senses the temperature of the leaving chilled water.
- **Condenser High Temperature Limit Switch**—If the temperature of the condenser rises above acceptable limits, this safety switch will also cause the hot water control valve to close and divert the hot water around the generator.
- **Chilled Water Flow Switch**—If the chilled water flow is interrupted, this safety switch will cause the hot water control valve to close and divert the hot water around the generator.
- **Thermal Delay Relay Lockout Delay and Timer**—If the unit is shut down for a period of time, this relay will lock out the unit for a period of time before it can be restarted.

ORIGINAL PAGE IS  
OF POOR QUALITY

# SPECIFICATIONS

MODEL WFB 300

DESIGN DELIVERED CAPACITY, Btu/h..... 306,000'

DESIGN DELIVERED CAPACITY, Tons I.M.E..... 25.5'

## ENERGY REQUIREMENTS

Design Hot Water Input, Btu/h..... 447,000  
 Design Hot Water Inlet Temperature, °F..... 195  
 Design Hot Water Outlet Temperature, °F..... 184.8  
 Permissible Range of Inlet Temp..... 160 to 200  
 Design Hot Water Flow, gpm..... 90  
 Pressure Drop, Feet of Water, at 90 gpm..... 20.7  
 Permissible Range of Flow, gpm..... 50 to 100  
 Pressure Drop, Feet of Water, at 100 gpm..... 25.6  
 Maximum Working Pressure, psig..... 100  
 Electrical Voltage, 60 Hz, 1 Phase..... 115<sup>2</sup>  
 Maximum Wattage Draw..... 300

## CHILLED WATER DATA

Design Inlet Temperature, °F..... 55  
 Design Outlet Temperature, °F..... 45  
 Design Flow, gpm..... 60  
 Pressure Drop, Feet of Water, at 60 gpm..... 9.8  
 Permissible Range of Flow, gpm..... 30 to 100  
 Pressure Drop, Feet of Water, at 100 gpm..... 26.9  
 Maximum Working Pressure, psig..... 100  
 Unit Water Volume, Gallons, Approx..... 12  
 Fouling Factor..... .0005

## CONDENSING WATER DATA

Design Heat Rejection, Btu/h..... 753,000  
 Design Inlet Temperature, °F..... 85  
 Design Outlet Temperature, °F..... 101.7  
 Permissible Range of Inlet Temp..... 75 to 90  
 Design Flow, gpm..... 90  
 Pressure Drop, Feet of Water, at 90 gpm..... 22.9  
 Permissible Range of Flow, gpm..... 50 to 110  
 Pressure Drop, Feet of Water, at 110 gpm..... 33.5  
 Maximum Working Pressure, psig..... 100  
 Unit Water Volume, Gallons, Approx..... 20  
 Fouling Factor..... .001

## FOR COOLING TOWER SELECTION

Maximum Heat Rejection, Btu/h..... 853,000  
 Range, °F..... 16 to 17  
 Minimum Permissible Sump Temperature, °F..... 75<sup>3</sup>

## SERVICE CONNECTIONS

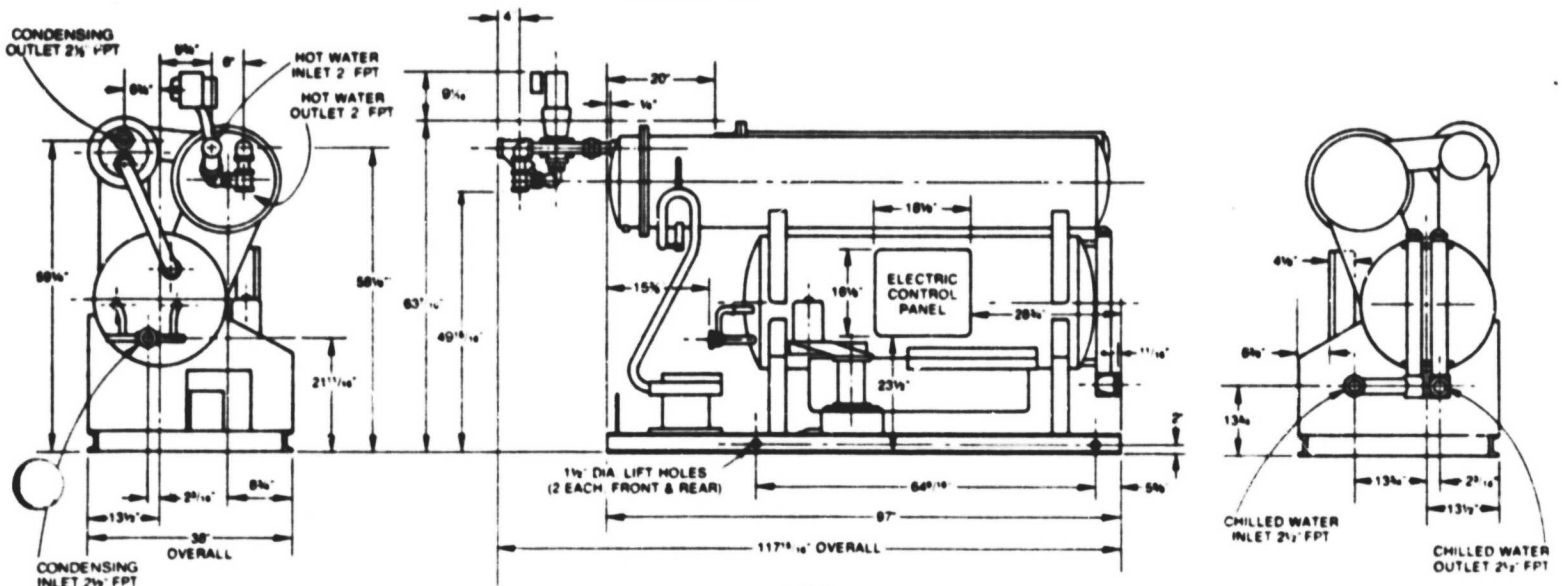
Hot Water Inlet and Outlet..... 2" FPT  
 Chilled Water Inlet and Outlet..... 2½" FPT  
 Condensing Water Inlet and Outlet..... 2½" FPT

## PHYSICAL DATA, APPROXIMATES

Operating Weight, Pounds..... 3,420<sup>4</sup>  
 Shipping Weight, Pounds..... 3,145<sup>5</sup>  
 Crated Size, Inches..... 114 W, 45 D, 69 H

- NOTES:** 1. Capacity at design conditions. For capacities at other conditions, see Page 4.  
 2. Units equipped for operation on 230V-50Hz-1Ph available on special order.  
 3. Thermostatic switch to control tower fan MUST be used. Set to "cut out" at 75°F.  
 4. Includes circulating water weights.  
 5. Units as shipped contain Lithium Bromide charge.  
 Application Manual (SA-41080) Available.

## DIMENSIONAL VIEWS



LEFT VIEW

125  
FRONT VIEW

WFB 300

RIGHT VIEW

# 15 TON 300 CAPACITY DATA

| CONDENSING WATER FLOW DATA |                |                    |                    |                    |                        |                                  |
|----------------------------|----------------|--------------------|--------------------|--------------------|------------------------|----------------------------------|
| Hot Water                  |                |                    | Chilled Water      |                    |                        |                                  |
| Flow Rate                  |                |                    | Temperature        |                    |                        |                                  |
| Hot Water Temp             | Hot Water Flow | Hot Water Pressure | Chilled Water Temp | Chilled Water Flow | Chilled Water Pressure | Hot Water to Chilled Water Ratio |
| 180                        | 152.8          | 132.000            | 40                 | 66.000             | 5.5                    | 198.00                           |
| 180                        | 154.8          | 148.200            | 45                 | 88.800             | 7.4                    | 238.00                           |
| 180                        | 156.8          | 178.800            | 50                 | 102.000            | 8.5                    | 277.80                           |
| 175                        | 163.1          | 132.800            | 40                 | 98.400             | 8.2                    | 271.00                           |
| 175                        | 165.1          | 148.800            | 45                 | 128.600            | 10.6                   | 347.50                           |
| 175                        | 167.1          | 177.800            | 50                 | 145.000            | 12.1                   | 372.60                           |
| 170                        | 165.1          | 214.300            | 40                 | 132.000            | 11.0                   | 346.30                           |
| 170                        | 164.5          | 241.700            | 45                 | 166.800            | 13.9                   | 407.50                           |
| 170                        | 164.0          | 262.400            | 50                 | 180.000            | 15.0                   | 442.40                           |
| 175                        | 169.1          | 257.000            | 40                 | 163.200            | 13.6                   | 420.20                           |
| 175                        | 168.7          | 277.800            | 45                 | 196.800            | 16.4                   | 474.40                           |
| 175                        | 168.2          | 297.500            | 50                 | 213.800            | 17.8                   | 511.10                           |
| 180                        | 173.1          | 302.400            | 40                 | 192.000            | 16.0                   | 494.40                           |
| 180                        | 172.8          | 313.800            | 45                 | 224.400            | 18.7                   | 538.20                           |
| 180                        | 172.3          | 344.200            | 50                 | 246.000            | 20.5                   | 587.20                           |
| 185                        | 178.1          | 352.300            | 40                 | 218.400            | 18.2                   | 570.70                           |
| 185                        | 178.0          | 354.900            | 45                 | 252.000            | 21.0                   | 606.90                           |
| 185                        | 177.5          | 380.700            | 50                 | 276.000            | 23.0                   | 656.70                           |
| 190                        | 180.9          | 396.000            | 40                 | 237.600            | 19.8                   | 633.60                           |
| 190                        | 180.8          | 400.000            | 45                 | 276.000            | 23.4                   | 676.00                           |
| 190                        | 180.4          | 421.500            | 50                 | 306.000            | 25.5                   | 727.50                           |
| 195                        | 184.7          | 448.700            | 40                 | 258.000            | 21.5                   | 706.70                           |
| 195                        | 184.8          | 446.700            | 45                 | 306.000            | 25.5                   | 752.70                           |
| 195                        | 184.6          | 451.600            | 50                 | 328.800            | 27.4                   | 780.40                           |
| 200                        | 188.7          | 490.900            | 40                 | 270.000            | 22.5                   | 760.90                           |
| 200                        | 189.0          | 481.800            | 45                 | 318.000            | 26.5                   | 799.80                           |
| 200                        | 188.6          | 493.200            | 50                 | 360.000            | 30.0                   | 853.20                           |

| 85° Inlet Condensing Water |       |         |    |         |      |         |
|----------------------------|-------|---------|----|---------|------|---------|
| 165                        | 162.8 | 96.800  | 45 | 60.000  | 5.0  | 156.800 |
| 170                        | 166.9 | 139.100 | 45 | 96.000  | 8.0  | 235.100 |
| 175                        | 170.7 | 188.000 | 45 | 134.000 | 11.2 | 322.400 |
| 180                        | 174.7 | 234.000 | 45 | 168.000 | 14.0 | 402.000 |
| 185                        | 178.7 | 274.000 | 45 | 195.600 | 16.3 | 469.600 |
| 190                        | 182.5 | 327.900 | 45 | 225.600 | 18.8 | 553.400 |
| 195                        | 186.6 | 365.500 | 45 | 237.600 | 19.8 | 603.100 |
| 200                        | 190.4 | 414.500 | 45 | 252.000 | 21.0 | 666.500 |

| 80° Inlet Condensing Water |       |         |    |         |      |         |
|----------------------------|-------|---------|----|---------|------|---------|
| 165                        | 160.4 | 122.000 | 45 | 72.000  | 6.0  | 194.000 |
| 170                        | 164.3 | 151.400 | 45 | 98.000  | 8.2  | 249.800 |
| 175                        | 167.9 | 186.600 | 45 | 128.400 | 10.7 | 315.000 |
| 180                        | 171.6 | 220.800 | 45 | 157.200 | 13.1 | 378.000 |
| 185                        | 175.4 | 253.300 | 45 | 182.400 | 15.2 | 435.700 |
| 190                        | 179.2 | 284.100 | 45 | 204.000 | 17.0 | 488.100 |
| 195                        | 183.1 | 312.700 | 45 | 222.000 | 18.5 | 534.700 |
| 200                        | 187.1 | 334.300 | 45 | 234.000 | 19.0 | 568.300 |

## FOR 15 TON OPERATION

Data in following table are with flows adjusted for 15 ton operation  
 Condensing Water Flow 54 gpm Hot Water Flow 54 gpm  
 Chilled Water Flow 36 gpm Temperatures in Degrees Fahrenheit

| 85° Inlet Condensing Water |       |         |    |         |      |         |
|----------------------------|-------|---------|----|---------|------|---------|
| 165                        | 160.4 | 122.000 | 45 | 72.000  | 6.0  | 194.000 |
| 170                        | 164.3 | 151.400 | 45 | 98.000  | 8.2  | 249.800 |
| 175                        | 167.9 | 186.600 | 45 | 128.400 | 10.7 | 315.000 |
| 180                        | 171.6 | 220.800 | 45 | 157.200 | 13.1 | 378.000 |
| 185                        | 175.4 | 253.300 | 45 | 182.400 | 15.2 | 435.700 |
| 190                        | 179.2 | 284.100 | 45 | 204.000 | 17.0 | 488.100 |
| 195                        | 183.1 | 312.700 | 45 | 222.000 | 18.5 | 534.700 |
| 200                        | 187.1 | 334.300 | 45 | 234.000 | 19.0 | 568.300 |

## PRESSURE DROP for Pump Sizing in Feet of Water at Flow Rate: Gallons per Minute

| Flow Rate (gpm)          | 50  | 75  | 100 | 125 | 150 | 175 | 200 | 225 | 250 |
|--------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Hot Water Circuit        | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 |
| Chilled Water Circuit    | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 |
| Condensing Water Circuit | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 |

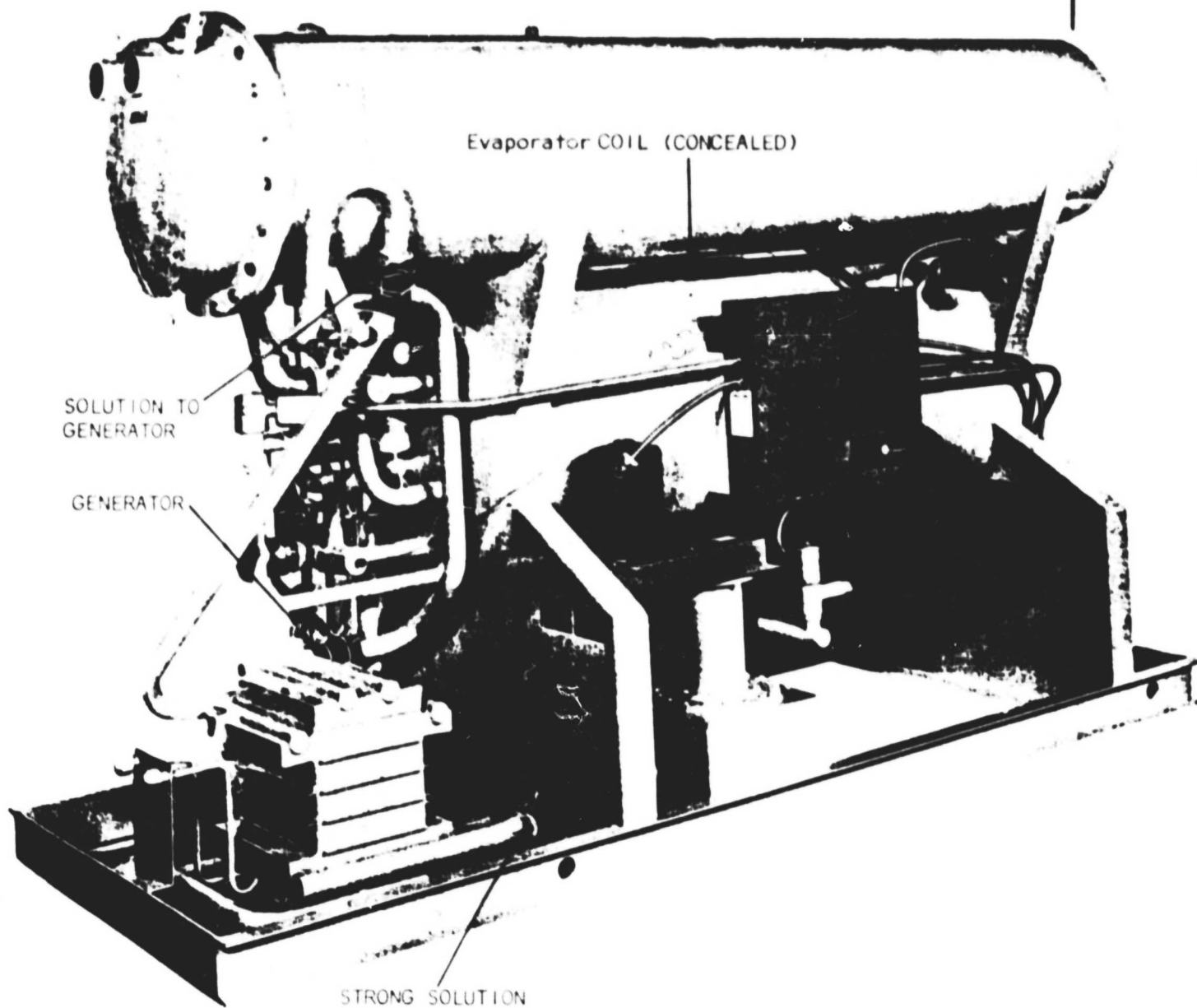
ORIGINAL PAGE IS  
 OF POOR QUALITY



## THERMOMETER WELL LOCATIONS

## MODELS

WFB-300



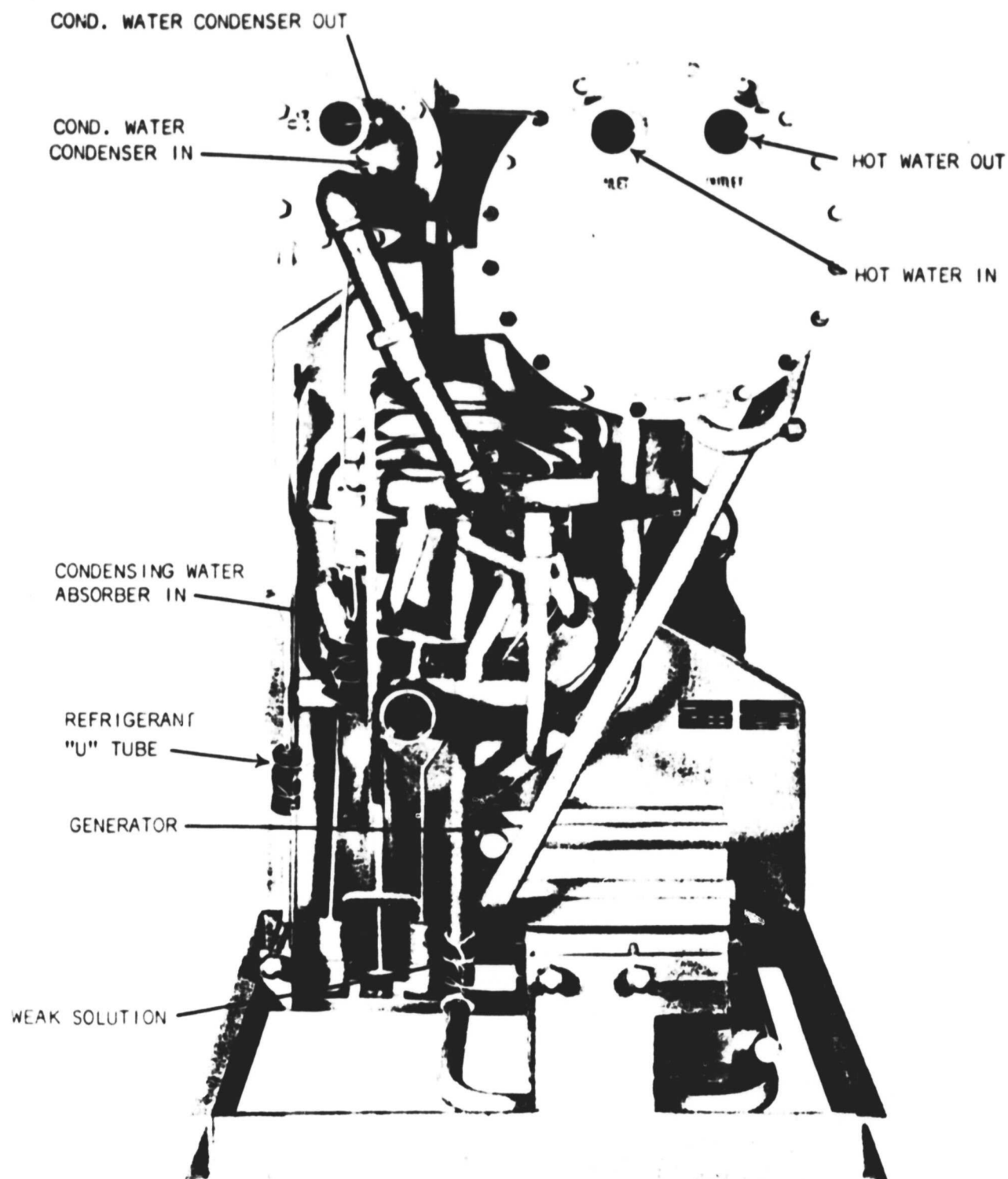
ORIGINAL PAGE IS  
OF POOR QUALITY

DATE: Jan., 1977

MODELS

WFB-300

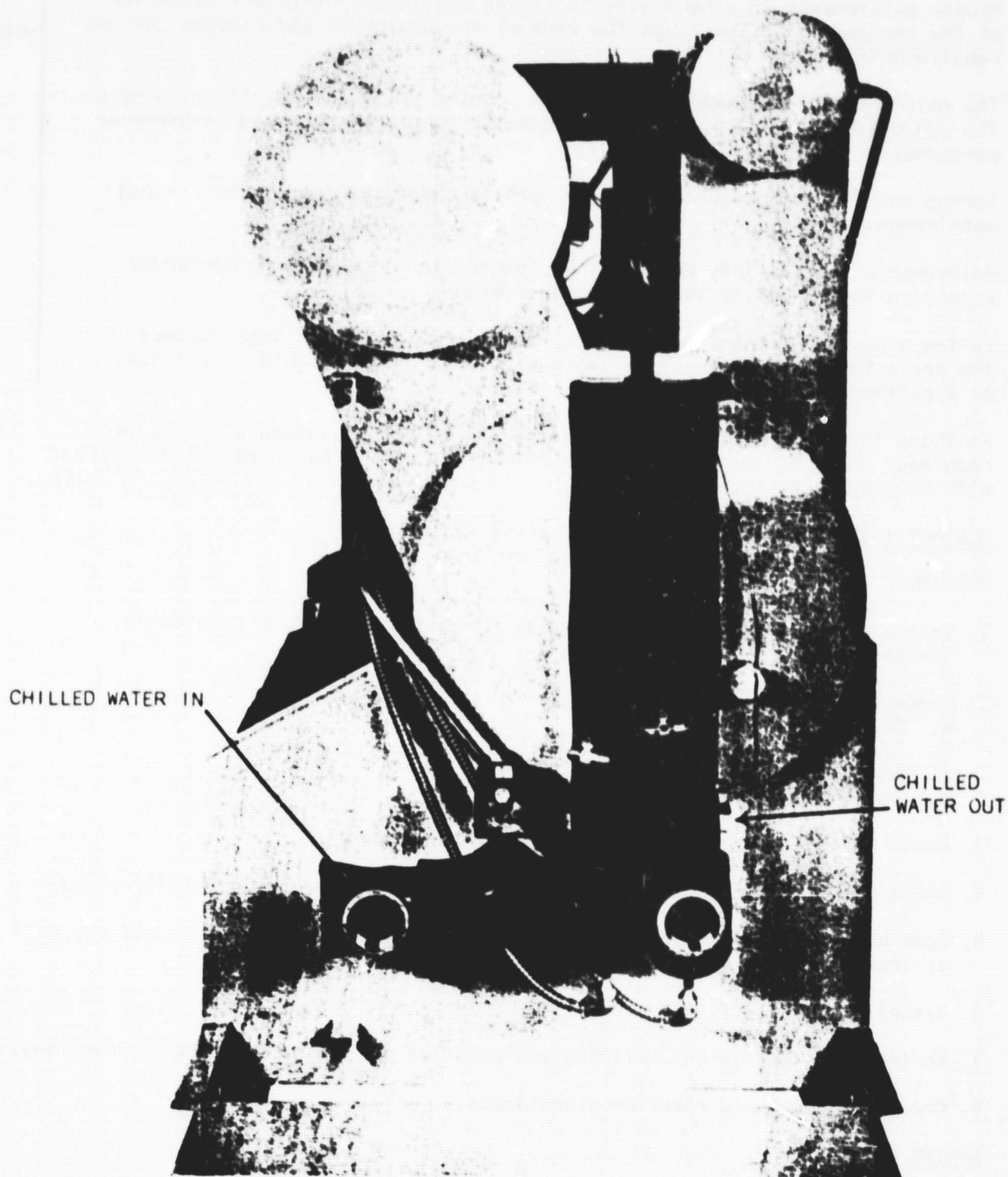
THERMOMETER WELL LOCATIONS



LEFT END VIEW



THERMOMETER WELL LOCATIONS



RIGHT END VIEW

ORIGINAL PAGE IS  
OF POOR QUALITY

MAINTENANCE

Proper maintenance is a necessity to insure continuous, efficient operation of the equipment. It prolongs the life of the equipment and reduces service requirements.

The maintenance requirements on Arkla's Solaire Units are relatively simple. The suggested monthly routine can be done by competent building maintenance personnel.

Spring and fall change-overs and any service should be handled by trained servicemen.

Maintenance on auxiliary equipment to the Arkla unit should be performed according to the manufacturer's recommendations.

In the suggested inspection routines, reference is made to page numbers in the Arkla Service Manual. This is to aid in finding the information needed on a particular subject.

As these inspections are made, all temperatures and adjustments should be recorded. Changes in temperature or conditions should be noted for discussion with the servicing agency.

MONTHLY INSPECTIONS

## COOLING:

1. Take a complete set of temperature readings (VI-15). If a problem is indicated, call servicing agency.
2. Check cooling tower;
  - a. Cleanliness of sump.
  - b. Cleanliness of sump screen.
  - c. Condition of fan belt.
  - d. Check water distribution system.
3. Check condensing water bleed-off flow rate (IV-35-2)
4. Check operation of condensing water chemical treatment equipment (if using).
5. Open all valves, on dirt legs and strainers, long enough to flush out any dirt or trash.
6. Visually check piping for leaks.
7. Perform maintenance on auxiliary equipment as per manufacturer's instructions.
8. Check equipment and area for cleanliness.

SPRING START-UPA. TOWER

1. Clean and flush distribution system and sump and sump strainer.

WFB-300

2. Replace all drain plugs, clean strainers, and close all drain valves.
3. Start filling tower sump.
4. Perform maintenance on tower fan motor and pump motor as per manufacturer's instructions.
5. Check condition and adjustment of tower fan belt.
6. When tower sump is filled, check adjustment of water level control.
7. Check fuses, start the condensing water pump.
8. After full flow of condensing water has been established, check the bleed-off flow rate (IV-35-2).
9. Check operation of condensing water chemical treatment equipment (if using).
10. After condensing water has been flowing at least 10 minutes, shut off pump.
11. Open valves on dirt legs and strainers and flush out any mud or trash.

B. UNIT

1. Perform maintenance on water pumps as per manufacturer's recommendations.
2. Check level of unit (IV-11-4).
3. Turn off manual hot water valve and then put unit into operation electrically.
4. Open valves on dirt legs just long enough to drain out any dirt or trash.
5. Clean filters.
6. Purge all air from chilled water system.
7. Check water piping for leaks.
8. Check chilled water flow rate (IV-25-4).
9. Check anti-freeze concentration (IV-29-2).
10. Check condensing water flow rate through unit (IV-32-4)
11. Check hot water flow rate through unit (IV-43-9).

C. CONTROLS

1. Check operation of weak solution by-pass valve and timer. See (V-75-4), (V-46-3(b)).
2. Check operation of tower fan sump switch. (IV-38-2)
3. Check operation of condensing water switch. (V-19-2)
4. Check operation of refrigerant dump valve. (V-16-2)

ORIGINAL PAGE IS  
OF POOR QUALITY

DATE: Jan., 1977

## MODELS

WFB-300

5. Check operation of chilled water low temperature switch. (V-12-4)
6. Check operation of flow switch. (V-15-1)
7. Check operation of evaporator low temp switch. (V-11-3)
8. Check hot water valve modulation. (IV-43-10)
9. Check all external controls in the system.

D. OPERATIONAL CHECK

1. Place thermometers in all thermometer wells (VI-15-6(A), (B), (C)).
2. Operate unit on cooling for at least 30 minutes or until all temperatures have stabilized.
3. Record temperatures.

SHUT DOWNA. TOWER

NOTE: If the condensing water system could be subjected to sub-freezing temperatures it is recommended that the system be flushed with a mixture of anti-freeze and water after performing the shut down procedure given below. This mixture should be capable of withstanding the lowest expected ambient temperature.

1. Close valve in tower make-up water line.
2. Open all drain valves and remove all plugs in condensing water system.
3. Clean and flush tower's distribution system.
4. Clean and flush tower sump.
5. Clean all strainers in condensing water system.
6. Circulate anti-freeze through condensing water circuit.
7. Remove fuses so that condensing water pump or tower fan cannot accidentally be operated without water.

B. UNIT

1. Turn off unit.
2. Open all valves to drain the condensing water circuit.
3. Turn off manual hot water supply valve to the unit. Open drain valves.
4. Check anti-freeze concentration (IV-29-2) and close chilled water valves at unit.
5. Touch up all rusty areas on unit by painting. Arkla Part No. Z-3181 Pizzaz (Orange Paint), or Gliddens Poly Urethane Floor Enamel, Color No. 15157(Tinted).



HEAT PIPE

HEAT RECOVERY

### Why Heat Recovery

In most commercial and industrial operations, there is a large amount of energy lost as waste heat that is typically exhausted into the atmosphere. No serious attempt has been made to recover this waste heat in the past, since, until recently, traditional forms of energy have been both abundant and relatively inexpensive.

This has changed drastically with the advent of increased prices that are projected to double or triple in the next five years, and fuel curtailments. Both affect present operations and threaten to limit future expansions without the availability of increased fuel supplies.

Today, air-to-air heat recovery has become an important means of reducing both growing costs and consumption. The Hughes HeatBank™ air-to-air heat recovery unit is currently being used in many commercial and industrial applications. Payback is attractive now and doubly attractive over the life of the HeatBank.

### Heat Recovery in Industry

Although industrial heat recovery presents a series of difficult design considerations with respect to high exhaust temperature, corrosive atmospheres and dirty air, it also presents the greatest opportunity for saving large amounts of waste BTUs. High temperature differentials, large air volumes, and many hours of operation make heat recovery a necessary consideration for any industrial heat user whether he is considering a new installation or retrofit.

The basic types of industrial air-to-air heat recovery can be characterized as process-to-process where heat is recovered from the exhaust air and returned to the process;

process-to-comfort where exhaust heat is recovered and used in comfort heating; and process exhaust temperature limiting as in the case of pollution control equipment.

### Heat Recovery in Heating,

### Ventilating and Air-Conditioning

Heat recovery involving heating, ventilating and air-conditioning (HVAC), is a viable way of conserving energy dollars for both retrofit and new construction systems. In new construction, not only are energy savings and reduced fuel costs realized, but the initial costs of the heating and cooling plant can be significantly reduced. Retrofit heat recovery is particularly attractive in systems which require 100% air change or where process exhausts can be used for space heating.

HVAC systems are characterized by large clean airflows and relatively low exhaust temperatures which mean low-cost standard materials of construction may be used. Important design considerations associated with HVAC systems are condensation, frost protection, and temperature output control.

The basic types of commercial recovery are comfort-to-comfort where the building exhaust heat is returned to the comfort conditioning system; and process-to-comfort make-up air systems. Comfort systems can also be further broken down into heating only, cooling only, or heating and cooling.

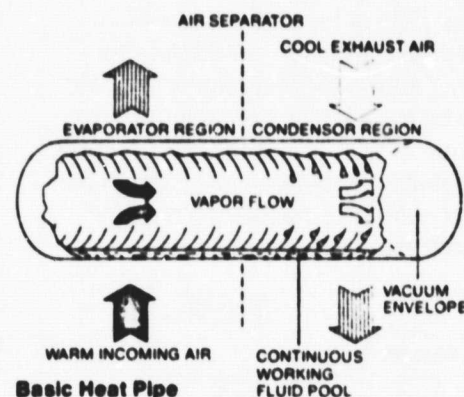
### What is The Hughes HeatBank Unit

The HeatBank unit has been designed for highly efficient recovery of waste heat in air-to-air applications. The units are completely passive heat exchangers that utilize the unique features of Hughes' heat pipes. The pipes transfer heat from the warm exhaust airstream to the cooler incoming airstream or from a warm incoming to a cooler exhaust airstream.

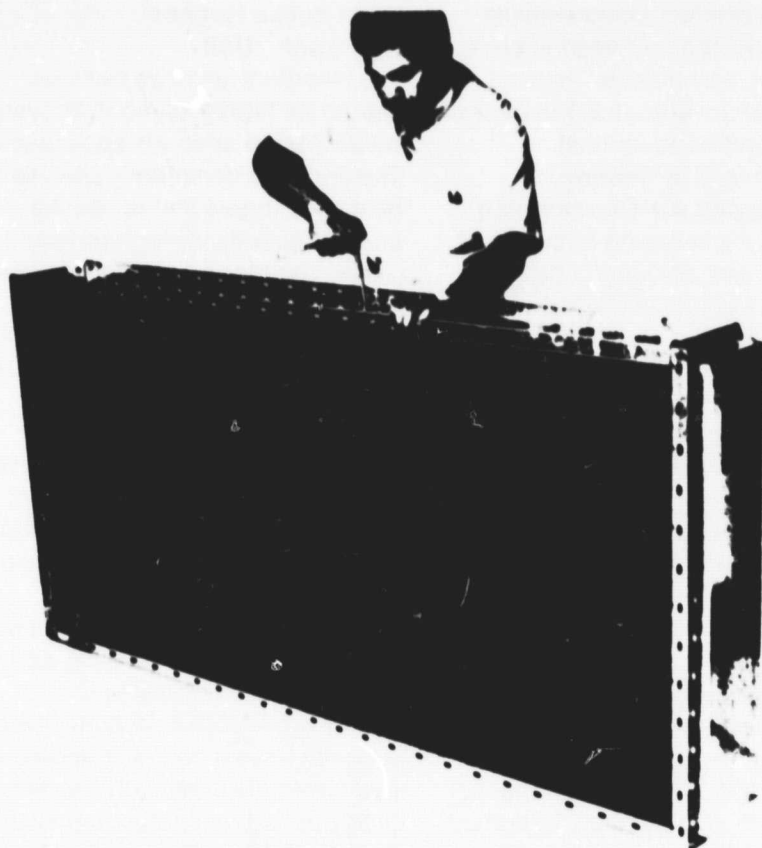
### What is a Heat Pipe

The ability of the HeatBank recovery unit to transfer large quantities of heat from one region to another is the result of the design and basic phenomenon of a heat pipe.

The basic heat pipe consists of a closed envelope containing a capillary wick structure and a small amount of vaporizable fluid. The heat pipe employs a boiling-condensing cycle with the continuous working fluid pool returning the condensed fluid back from the cooler end (condenser) to the heat input area (evaporator). The temperature loss between the evaporator and condenser is very small resulting in an almost isothermal process.

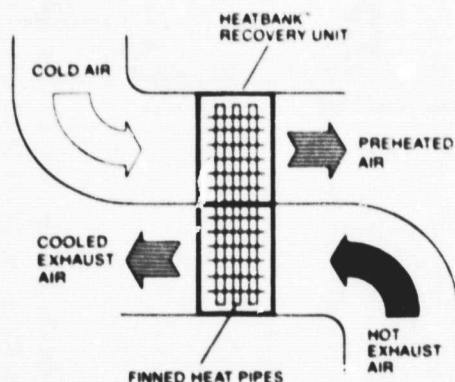






#### Hughes HeatBank™ Heat Pipe Recovery System

By combining a few to several hundred heat pipes with extended area fins into a HeatBank coil, a thermal path is created between two separate counterflow airstreams. This allows large quantities of heat to be transferred from one region to another with low temperature drops, high efficiency, no cross contamination, and with no moving parts or external power requirements.



Counter-Flow Operation

Maximum efficiency is obtained from the HeatBank heat recovery unit when the hot and cold airstreams are next to each other. Since the heat pipe is a continuous vacuum tube, it is not practical, from either a cost standpoint or a heat loss standpoint, to have large separations between the two airstreams.

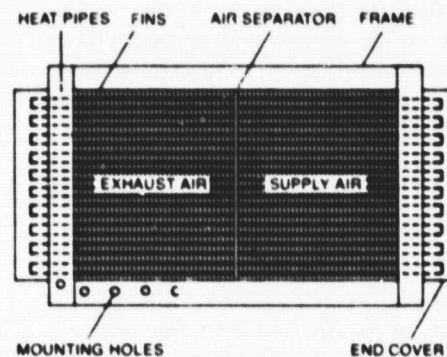
Although the performance of a heat pipe is enhanced by tilting the unit to aid the gravity return of the working fluid, the pipe can operate in a completely horizontal position. Thus, the pipes in the unit will operate bi-directionally in two-season HVAC applications where only the flow of the warm and cool airstreams change.

**HeatBank Features**  
 High Recovery Efficiency  
 Physical Separation of Airstreams  
 Compact Size  
 Lightweight Construction  
 Low Pressure Drops  
 Minimum Maintenance  
 Long Life  
 No Moving or Load Bearing Parts  
 No External Power Requirements  
 Compatible with Standard Dampers and Controls  
 Simple Ducting Requirements  
 Wide Range of Unit Sizes and Temperature Ranges  
 Easily Cleaned

#### HeatBank™ Models Available

HeatBank units are manufactured to operate within specific temperature ranges for various applications shown in the table.

A variety of materials are used in the construction of the basic components in the HeatBank unit to meet the operational parameters of each application. Standard materials of construction are aluminum for the fins and heat pipes and galvanized steel for the frame, covers and air separator. Copper, carbon and stainless steel are also used for specialized applications. In such applications, the HeatBank unit can also be coated with materials to withstand a variety of atmospheric conditions.



Basic Components of HeatBank™ Unit.

Fin spacing is available from 4 through 14 fins per inch in virtually any number of heat pipe rows deep. Typical efficiencies are in the 60 to 70 percent range with standard pressure drops of 1 inch of water or less.

## Models and Temperature Ranges

| SERIES MODEL NUMBER | MAXIMUM EXHAUST TEMPERATURE (F) | SUGGESTED APPLICATIONS   |
|---------------------|---------------------------------|--|
| T 15                | 150                             | comfort-to-comfort   |
| T 30                | 300                             | moderate temperature process-to-comfort and process-to-process |
| T 40                | 400                             | higher temperature process-to-comfort and process-to-process   |
| T 50                | 500                             | higher temperature process-to-comfort and process-to-process   |
| T 60                | 600                             | higher temperature process-to-process                          |

\*The maximum exhaust temperature rating is based on the highest temperature to which the unit might be subjected. This assures reliability of the unit under a worst-case condition, such as diminished incoming air flow. Under normal operating conditions, the average temperature of the unit will be lower than the maximum exhaust temperature. Higher temperature exhaust can be accommodated under other conditions such as unbalanced airflows or with the use of protection systems.

## Comparison to Other Systems

To evaluate the primary types of air-to-air heat recovery systems, their operating characteristics must be compared. In the chart, the operating characteristics of different units are listed and rated. The rating numbers are assigned from 0 to 5 with the

higher numbers assigned to the most desirable characteristics. From these ratings and the operating characteristics, we feel that the most attractive is the heat pipe unit. In order to compare these systems, a completely detailed applications analysis must be made.

## Comparison of Heat Recovery Units

| UNIT TYPE       | PRESSURE DROP $R_N$ |   | HEAT TRANSFER FILM COEFFICIENT $R_N$ |   | MAINTENANCE EFFORT $R_N$ |   | COST $R_N$ | AUXILIARY POWER | CROSS CONTAMINATION $R_N$ |   | TRANSFER AREA PER VOLUME |   | TOTAL RATING |
|-----------------|---------------------|---|--------------------------------------|---|--------------------------|---|------------|-----------------|---------------------------|---|--------------------------|---|--------------|
| Regenerators    | Mod                 | 3 | High                                 | 4 | High                     | 2 | High 2     | Yes             | Yes                       | 0 | High                     | 4 | 15           |
| Shell & Tube    | High                | 2 | High                                 | 4 | Mod                      | 3 | Mod 3      | No              | No                        | 5 | Low                      | 2 | 19           |
| Plate           | Low                 | 4 | Mod                                  | 3 | Mod                      | 3 | High 2     | No              | No                        | 5 | Very High                | 5 | 22           |
| Secondary Fluid | Low                 | 4 | Low                                  | 2 | High                     | 2 | High 2     | Yes             | No                        | 5 | Mod                      | 3 | 18           |
| Heat Pipe       | Low                 | 4 | High                                 | 4 | Very Low                 | 5 | Mod 3      | No              | No                        | 5 | High                     | 4 | 25           |

$R_N$  Relative rating numbers are assigned from 0 to 5. 5 is assigned to the best characteristics and 0 is assigned to unacceptable characteristics.

## To Get More Information

This brochure is designed to give you a general idea of when and where to consider heat recovery and how our product might meet your needs.

If you have a specific application and need more information tailored to your requirements, we have provided a return post card for your convenience in requesting such information.

If there is no address label on the card, please complete the address section. Please do not obliterate the label if corrections must be made. Just cross out the information to be corrected and write in new information.

I need more information on your HeatBank unit. Send me literature on:

☐ Industrial heat recovery ☐ HVAC heat recovery

☐ have an applications engineer contact me. My phone: \_\_\_\_\_

My requirement can best be described as: \_\_\_\_\_

Exhaust temperature range(s): \_\_\_\_\_ Exhaust air volume (SCFM): \_\_\_\_\_

Contaminants/Particulates \_\_\_\_\_

I am a: ☐ consultant ☐ contractor ☐ packager ☐ OEM

☐ end user - Please describe type of industry \_\_\_\_\_

Name \_\_\_\_\_ 052-08036 PKLLI 1770303-982-731

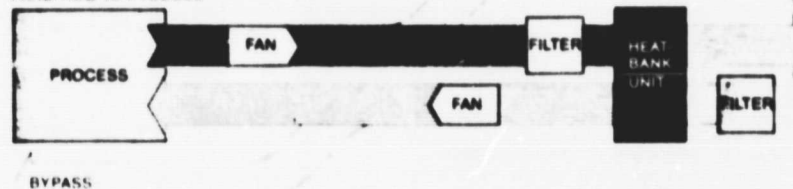
Company \_\_\_\_\_ PK LITTLE

Address \_\_\_\_\_ HAIMESPORT, IND PK

City \_\_\_\_\_ HAIMESPORT, NJ 08036

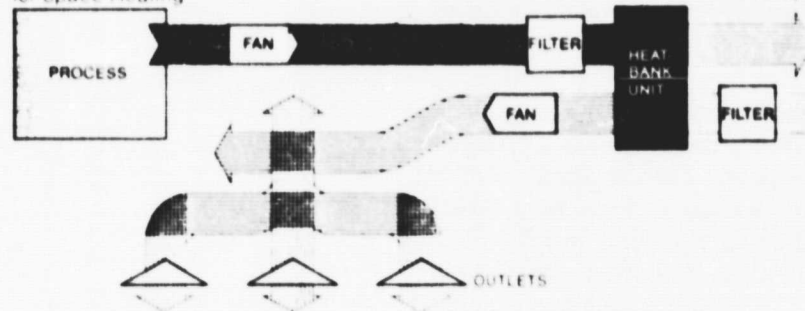
### Typical Process-to-Process

Recovered Process Exhaust Heat  
Returned to Process



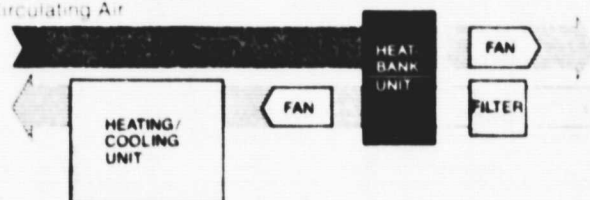
### Typical Process-to-Comfort

Recovered Process Exhaust Heat  
for Space Heating

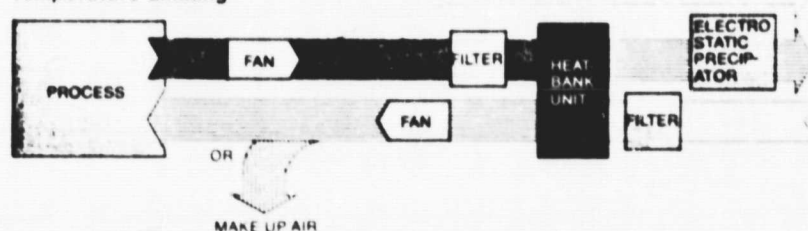


### Typical Comfort-to-Comfort

Building Exhaust to Pre-Heat or  
Pre-Cool Circulating Air



### Typical Process Exhaust Temperature Limiting



### Typical Industrial Applications

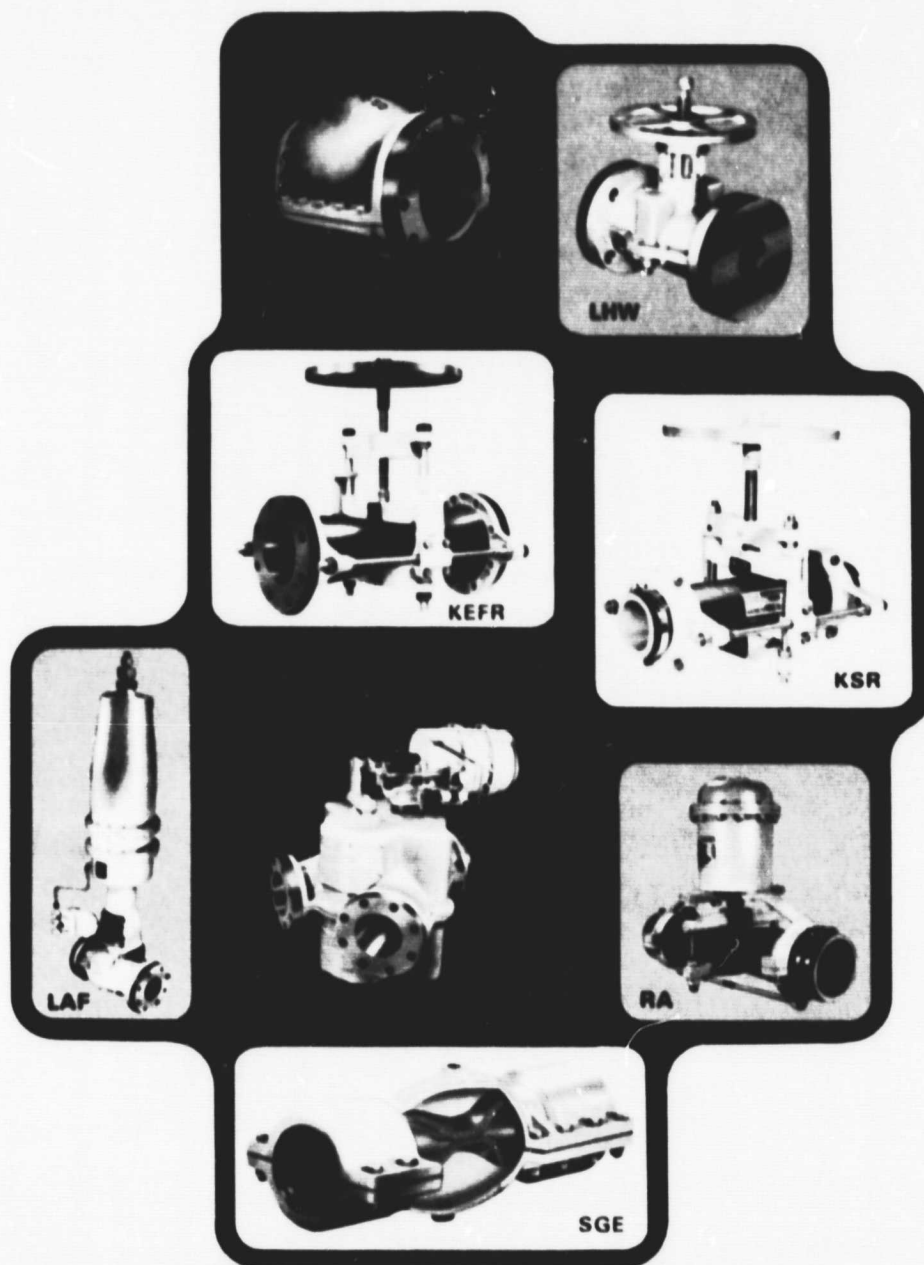
Paint Drying Ovens  
Food Dryers  
Grain Dryers  
Pellet Dryers  
Plasticizer Curing Ovens  
Foundry Furnaces  
Print Dryers  
Film Dryers  
Laundry Dryers  
Dehumidifiers  
Food Processing Ovens  
Boiler Pre-Heaters  
Heat Treating Areas  
Paper Dryers  
Plating Tanks  
Tobacco Dryers  
Textile Ovens  
Chemical Dryers  
Laboratory Exhausts  
Pollution Control  
Paint Spray Booth

### Typical HVAC Applications

Apartment Buildings  
Banks  
Municipal Buildings  
Indoor Pools & Rinks  
Indoor Tennis Courts  
Hospitals  
Nursing Homes  
Industrial Plants  
Research Laboratories  
Office Buildings  
Schools & Colleges  
Sports Complexes  
Theaters/Auditoriums  
Animal Laboratories  
Restaurants  
Dining Halls  
Commercial Kitchens  
Department Stores  
Supermarkets  
Hotels  
Computer Rooms  
Clean Rooms

**SOLAR CONTROL VALVES**





## RKL PINCH VALVES

RKL CONTROLS INC., ARK RD., LUMBERTON, N.J. 08048  
Phone (609) 267-2800 • Telex 831-692



# TABLE OF CONTENTS

| TABLE OF CONTENTS  |  |
|--|--|
| PRINCIPLES OF DESIGN & OPERATION   |  |
| EXCLUSIVE CONSTRUCTION FEATURES (Series LHW)   |  |
| INDUSTRIAL USERS, TYPES OF ELASTOMERS AVAILABLE, CONSTRUCTION FEATURES OF ELASTOMER BODY.  |  |
| <b>SERIES L:</b> Totally enclosed elastomer body—Pre-Pinched design—Pneumatic, Hydraulic and Electric operators for Control Valve service, Sizes 1" — 24"  | <br>L                     |
| <b>SERIES SGE:</b> Totally enclosed elastomer body—Slip-on connections (eliminates companion flanges)—Air or Hydraulically operated—No moving parts—On-off or rough flow control, Sizes 1/4" — 4"  | <br>SGE                   |
| <b>SERIES SG:</b> Totally enclosed elastomer body—Flanged connections—Air or Hydraulically operated—No moving parts—On-off or rough flow control, Sizes 1" — 18"   | <br>SG                    |
| <b>SERIES KSR:</b> Open pinching mechanism surrounds elastomer body—Slip-on connections—Hand wheel operated—Full round opening, Sizes 1/4" — 8"  | <br>KSR                   |
| <b>SERIES KEFR:</b> Open pinching mechanism surrounds elastomer body—Flanged connections—Hand wheel operated—Full round opening, Sizes 1" — 18"  | <br>KEFR                 |
| <b>SERIES R:</b> Open pinching mechanism surrounds elastomer body—Pre Pinched design—Flanged or slip-on connections—Pneumatic, Hydraulic and Electric operators for Control Valve service, Flanged Sizes 1" — 14", Slip-On Sizes 1/4" — 8" | <br>R                   |
| <b>SERIES KHL AND KHLF:</b> Open pinching mechanism surrounds elastomer body—Pre-Pinched design—Slip-on or Flanged connections—Quick acting on-off hand lever operated, Slip-on Sizes 1/4" — 8", Flanged Sizes 1" — 8"                     | <br>KHL AND KHLF        |
| <b>SERIES LHW—BG:</b> Bevel Gear Operated — Totally enclosed elastomer body — Pre-Pinched design<br>Custom Designs: Oval opening — Chain Wheel Actuators — Infinitely variable orifice valve   | <br>BEVEL GEAR OPERATED |
| <b>SERIES DV (DIVERTER VALVE):</b> World's only 3-way pinch valve—Totally enclosed elastomer body—Full round opening—On-off or proportional control—Pneumatic, Hydraulic or Electric operators   | <br>OVAL                |
| <b>SIZING PROCEDURE</b> —Flow curves—Friction loss capacity charts—Conversion factors  | <br>DV (DIVERTER VALVE) |
| <b>CHEMICAL RESISTANCE CHARTS</b>  |  |
| <b>TYPICAL APPLICATIONS</b>  |  |
| <b>HOOK-UP DIAGRAMS</b> —Pneumatic & Hydraulic   |  |
| <b>HOW TO ORDER—OTHER RKL PRODUCTS</b>   |  |

ORIGINAL PAGE IS  
OF POOR QUALITY



# PRINCIPLES OF DESIGN AND OPERATION

***superior control performance without maintenance problems***

## **A SIMPLE DESIGN PRINCIPLE SUITABLE FOR 95% OF VALVE APPLICATIONS**

The RKL pinch valve operates, as its name implies, on the simple principle of pinching a rubber tube (the body) to effect flow control. Though the principle initially was used to cope with abrasive and corrosive materials, RKL valves are used today in practically every industry. The transformation of the pinch valve from specialized to general-purpose use is predicated primarily upon RKL's success in adapting natural and synthetic rubbers (elastomers) to the rigors of a valve body that must withstand innumerable pinching cycles without cracking. By evolving special compounds and production techniques, RKL has been able to significantly lengthen the service life of a fabric reinforced valve body and, equally important, has been able to develop a diversified line of valve bodies and pinching mechanisms that fit a broad range of application requirements in Chemical, Mining and Process industries. They are also ideally suited for sewage, water treatment and smoke abatement applications.

## **STRAIGHT-THROUGH FLOW ELIMINATES TURBULENCE, INCREASES CAPACITY**

RKL pinch valves have two inherent design advantages over other valve types. They permit straight-through flow in either direction, and they are completely free of any obstructions, moving parts or cavities within the flow pattern that might adversely affect fluid flow or create servicing problems. Together, these two facts are the basis of exceptional, maintenance-free performance.

RKL valves provide absolutely gas-tight and vacuum tight shutoff because there are no seats, discs or packing glands to leak. Also, they exhibit excellent flow characteristics. What's more, the completely unobstructed passage through the body eliminates flow turbulence to the extent that RKL valves have a throttling ratio of 5 to 1. This compares well with the valve norm of 3 to 1. An RKL valve can throttle a flow on 1000 GPM down to 200 GPM without turbulence.

## **TROUBLE-FREE DESIGN SAFE EVEN FOR SANITARY APPLICATIONS**

There is virtually nothing that can go wrong with an RKL valve. It requires no routine lubrication and cannot stick under any conditions. Its simple, straight-through design is completely free of cavities in which entrained solids or contaminating materials can be deposited. Consequently, the RKL valve can handle any material, including slurries and corrosive fluids, within its temperature and pressure limits—without maintenance. It is also used for sanitary service in food and drug processing.

## **(PRE-PINCHED) AND (FULL ROUND) DESIGN**

Since a full round flexible tube doesn't appreciably restrict flow until it is pinched to 50% of closure, RKL originated the PRE PINCHED design which is able to handle flows within 2% of full pipe capacity. As soon as the upper pinch bar moves from full open towards the closed position, in a Pre-Pinched valve, flow control occurs. Shut off takes place slightly below the valve's centerline.

In some applications where bridging, high velocities, and particles larger than  $\frac{1}{2}$  the pipe diameter occur, a FULL ROUND opening pinch valve is required. The full round valves are available, as are the Pre Pinched valves, with hand, pneumatic, hydraulic and electric operators in both the open and enclosed construction. However, before flow control occurs, a full round pinch valves must be closed to 50% of the full open position.

## **LESS EXPENSIVE TO INSTALL, EASIER TO INSPECT**

All RKL pinch valves (except the solenoid-operated model) are self-supporting. Those with slip-on connections have enlarged ends that fit over the piping and are held in place with two hose clamps. The valves with flanged connections feature full faced flanges that are an integral part of the rubber body and are backed up by metal flanges. Installation is simple; no floor columns, ceiling hangers, or separate mounting brackets are required. Once installed, the valve is always accessible for normal inspection. Each RKL Valve is fully tested for gas tight closure and control operation under actual specified line pressure conditions, on our test rack, before shipment. Also each valve is fully assembled for immediate installation.



## EXCLUSIVE CONSTRUCTION FEATURES:

### OVER-PINCHING PROTECTION

Positive stops on all RKL valves prevent the valve body from being pinched beyond the point of gas-tight closure, eliminating unnecessary wear. Stem cover optional.

### LARGER BEARINGS

Bearing surfaces are extra large for easy operation. They are equipped with nylon washers and grease fittings for ease of lubrication.

### "O" RING SEALS

Seals completely isolate the stem thread mechanism in case of body failure.

### FOOLPROOF PINCHING MECHANISM

The simple, direct-acting pinching mechanism operates in any position and has no linkage to bind.

LIGHTWEIGHT ALUMINUM OR  
CAST-IRON HOUSING

REMOVABLE DRAIN PLUG

SELF-SUPPORTING

MOLDED FABRIC

PATENTED POSITIVE OPENING

# TYPES AND SIZES FOR VARIOUS APPLICATIONS

| Industry & Application | Types Used       | Size Range |
|------------------------|------------------|------------|
| <b>PAPER</b>           |                  |            |
| Pulp Stock             | SG-L-RAF-KFR     | 2"-12"     |
| Alum                   | SG-L-RAF-KSR-Rs  | 1/2"-6"    |
| Reg Stock              | SG-L-RAF-KFR     | 2"-10"     |
| Bleach Liquor          | L-RAF-RA-KFR     | 1"-12"     |
| Green Liquor           | L-RAF-KHL-KFR    | 1"-12"     |
| Milk of Lime           | L-RAF-RA-KFR     | 1"-8"      |
| White Liquor           | L-RAF-KFR-KSR    | 1"-12"     |
| <b>FOOD</b>            |                  |            |
| Vegetable Purée        | L-RAF-KSR-KHL    | 1"-3"      |
| Apple Juice            | L-KHL            | 2"-6"      |
| Pineapple Juice        | L-RAF-KFR        | 1"-6"      |
| Sweet Water            | L-RAF            | 1"-6"      |
| Sugar Pulp             | RAF-KFR          | 2"-8"      |
| Sugar Granules         | L-RAF-KHL        | 4"-10"     |
| Pickle Broth           | KSR-RA           | 2"-4"      |
| Beer                   | LAF-LHW          | 1"-6"      |
| <b>GLASS</b>           |                  |            |
| Sand Slurry            | SG-L-RAF-REF-KFR | 2"-12"     |
| Ceramic Slip           | L-RAF-RA-KFR-KSR | 1"-6"      |
| Porcelain Frit         | L-RAF-KFR-RA-KSR | 1/2"-3"    |
| Grinding Compound      | RA-KHL-Rs        | 1/4"-2"    |
| <b>MISCELLANEOUS</b>   |                  |            |
| Cement & Asbestos      | RAF-LAF-KFR      | 4"-8"      |
| Latex                  | L-RAF-KSR-RA-Rs  | 1/4"-6"    |
| Carborundum Granules   | RAF-RA           | 2"-6"      |
| Plaster of Paris       | SG-L-RAF         | 1"-3"      |
| Lime Slurry            | SG-L-RAF-REF-Rs  | 1/4"-8"    |
| Sewage Effluent        | SG-L-RAF-KFR-REF | 2"-16"     |

| Industry & Application | Types Used       | Size Range |
|------------------------|------------------|------------|
| <b>MINING</b>          |                  |            |
| Taconite Slurry        | SG-L-KFR-REF     | 1"-16"     |
| Sand & Water           | SG-L-KFR-RAF     | 3/4"-10"   |
| Coal Fines & Water     | SG-L-KFR-RAF     | 2"-14"     |
| Dusty Air              | SG-RAF-KHL       | 1/4"-12"   |
| Acid Leach Solution    | L-KFR-Rs         | 1/4"-14"   |
| Flotation Media        | SG-KSR-KFR-RAF   | 1"-8"      |
| Acid Mine Water        | L-KFR-RAF-KSR    | 1"-10"     |
| Phosphate Slurry       | L-KFR-RAF        | 1 1/2"-16" |
| Cement Slurry          | SG-LAF-LEF-LHW   | 4"-12"     |
| Potash Slurry          | SG-L-KFR-RAF     | 2"-18"     |
| Clay Slurry            | SG-L-KFR-RA      | 1"-6"      |
| Titanium Oxide         | L-RAF-KFR-Rs     | 1"-8"      |
| Ilmenite               | L-KFR-RAF-KSR    | 2"-14"     |
| Copper Ore Slurry      | SG-L-KFR-REF     | 2"-18"     |
| Lead Ore Slurry        | SG-L-KFR-KSR     | 1"-8"      |
| Nickel Ore Slurry      | KFR-L-KHL        | 1"-10"     |
| Uranium Ore Slurry     | L-KFR-RAF-KSR    | 1"-14"     |
| <b>CHEMICAL</b>        |                  |            |
| Benzene & HCL          | KFR-RAF-LAF      | 4"-8"      |
| Detergents             | LHW-LAF          | 3/4"-4"    |
| Salt Water             | L-KFR-RAF        | 1"-12"     |
| Catalysis Granules     | SG-L-RAF         | 2"-8"      |
| P.V.C. Granules        | SG-RA-KSR        | 1 1/2"-6"  |
| Nitroglycerin          | RA-KHL-KSR       | 1"-4"      |
| Explosive Powders      | SG-L-KFR-KSR     | 1/2"-10"   |
| Carbonates & Water     | SG-L-KFR-KHL     | 1/2"-8"    |
| Sodium Silicate        | SG-L-RAF         | 1/2"-8"    |
| Carbon Powder          | SG-RAF-KSR-KHL   | 1"-10"     |
| Salt Cake              | SG-KFR-RAF       | 2"-8"      |
| Distilled Water        | KFR-KSR-RA-KHL   | 1/2"-4"    |
| Magnesium Slurry       | SG-KFR-RAF-L     | 1/2"-6"    |
| Acids (all types)      | L-KFR-RAF-KHL-Rs | 1/4"-12"   |

## ELASTOMERIC BODIES

A CHOICE OF BODIES TO MEET ANY OPERATING CONDITIONS

RKL has developed, over the last 15 years, special low durometer, high tensile elastomeric compounds to meet the demanding corrosion and abrasion resistance required for long life in pinch valve bodies.

The formulation of these compounds varies depending on the application. However, the general characteristics of the elastomer are shown.

Any elastomer not listed may be had on special application.

Note: (O&T) = Odorless and Tasteless

DUPONT TRADEMARKS

| COMPOUNDS        | CHARACTERISTICS   |
|------------------|---|
| FCR              | Excellent Corrosion & Abrasion Resistance                   |
| GRS              | Excellent Combination of Abrasion & Temperature Resistance  |
| BUNA N           | Good Solvent and Hydrocarbon Resistance                     |
| NEOPRENE         | Good Chemical and Hydrocarbon Resistance                    |
| NEOPRENE (O&T)   | White Compound with Good Chemical and Abrasion Resistance   |
| BUTYL            | Good Combination of Chemical & Temperature Resistance       |
| BUTYL (O&T)      | White Compound with Good Animal & Vegetable Oil Resistance  |
| HYPERON          | Excellent Chemical & Temperature Resistance                 |
| FCR (CONDUCTIVE) | Good Dry Abrasion Resistance at High Velocities             |
| VLON             | Outstanding Chemical & Temperature Resistance               |
| SILICONE         | Good Combination of High & Low Temperature Resistance       |
| EPDM             | Excellent Heat & Chemical Resistance                        |
| FDA RUBBER       | Food & Drug applications with excellent abrasion resistance |
| POLYURETHANE     | Excellent Abrasion & Hydrocarbon Resistance                 |

### BODY CONSTRUCTION FEATURES:

Only a GENUINE RKL pinch valve body is fully molded from flange to flange or connection to connection in all sizes thru 24 inches. RKL is the only manufacturer to fully mold its fabric reinforced pinch valve bodies using special compounds made to their exacting specifications for high corrosion and abrasion resistance. The molding operation means no delamination such as occurs in hand wrapped bodies, and consequently longer life expectancy. The specially woven fabric reinforcement is plyed into the construction in such a way that the body has high flexibility and exceptionally high burst strength. Each flange is tapered for a tighter seal against high line pressures. They are drilled to either 150# or 300# ANSI flange standards and being full faced offer the best possible seal against leakage at the flanges. The fully patented positive opening feature is molded into the body as separate tabs from the reinforcing fabric. No metal inserts are used and the flexibility of these tabs does not hinder the gas tight seal upon closure.

## HANDWHEEL - PNEUMATIC - HYDRAULIC - AND

### FOR THE ULTIMATE IN FLOW CONTROL

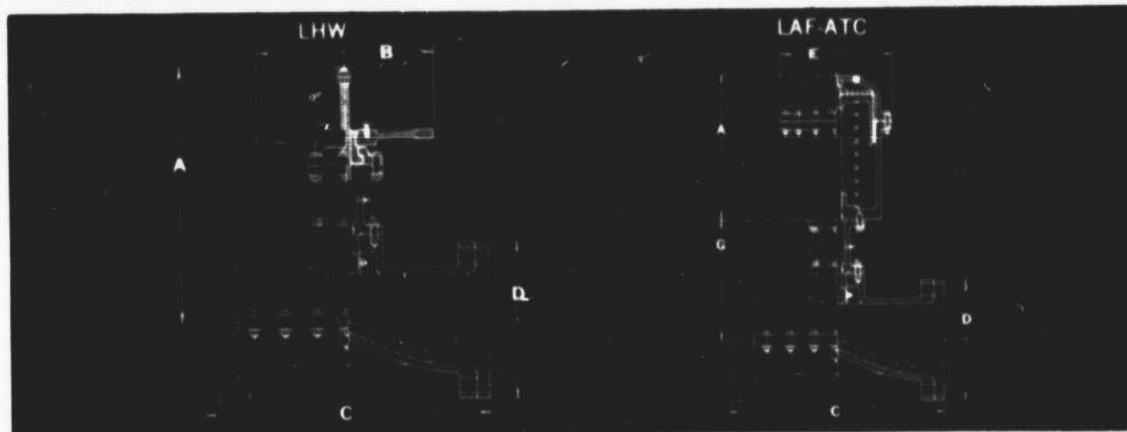
The RKL Series L pinch valve is unsurpassed for repeatable process control from computer programs, instrument air signals or milliamp electric signals.

The fully enclosed, fully self supported housing, offers maximum protection in highly corrosive atmospheres and from possible elastomer body rupture. It also can be specified for vacuum service so that a dead end vacuum may be applied between the housing and the elastomeric body to equalize a vacuum pressure within the pinch valve body. This allows the series "L" pinch valve to be used on any vacuum application.

By specifying the correct elastomeric body this series can be used on abrasive or corrosive service within a pressure range of  $10^{-10}$  vacuum to 300 psig and a temperature range of  $-100^{\circ}\text{F}$  to  $550^{\circ}\text{F}$ , depending on application.

The full faced tapered elastomer flanges offer the most positive flange sealing available and the exclusive fully molded fabric reinforced body construction means no problems with replacement bodies not fitting and no delamination of the pinch valve body tube. When the fully patented positive opening feature is used there is no need to rotate the pinch valve body to prevent it from taking a permanent set.

All series "L" actuators are totally enclosed for use in dusty atmospheres or exposure to the elements. They are of the non-rising actuator type so that they can be piped for air operation or wired for electric operation without the use of flexible air hoses or flexible conduit. The various types of actuators are shown opposite on page 7. • Sizes larger than 14 inch are available on application.



\*\*Available Up To 24" Size

H.W.—Handwheel Operated  
ATCP—Air-To-Close With Positioner  
ATC—Air-To-Close (open on air failure)  
ATOP—Air-To-Open With Positioner

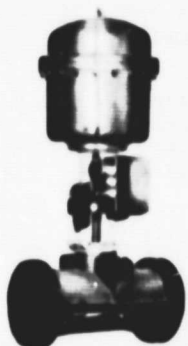
ATO—Air-To-Open (close on air failure)  
ATOSP—Air-To-Open, Spring To-Close  
LEF—Electrically Operated  
ADA—Air-To-Open, Air-To-Close

\*ALSO AVAILABLE WITH CHAIN  
WHEEL OPERATOR (SEE PAGE 15)

ORIGINAL PAGE IS  
OF POOR QUALITY



# ELECTRICALLY OPERATED VALVES *SERIES "L" for all pressure*

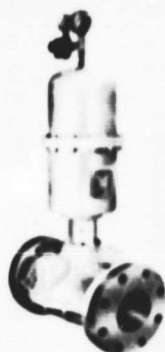
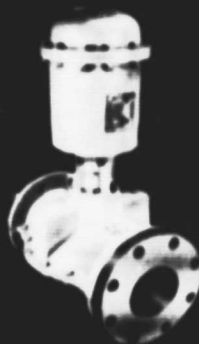


## **Open Stem Yoke Construction**

The open stem yoke design on our "L" series pinch valve is used to mount indicating switches, stem indicator, auxiliary manual hand-wheel and various makes of side mounted positioners, e.g. Bailey, Fisher, Hammel Dahl, Honeywell, Masoneilan, Moore and Taylor.

**LAF-ATC-P W/BAILEY AP 2**

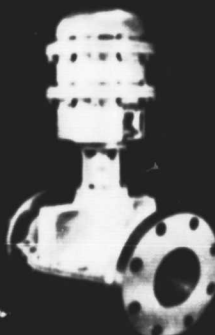
*See Bulletin # 477*



## **Air-to-Open, "Fail Closed"**

This long stroke, patented, trapped air rolling diaphragm actuator, (Rollomotor) has a small diameter for use on air pressures up to 125 psig. It will not drift open after prolonged air failure. Furnished with two gauges, PRV and check valve, as standard. No external air tank required. It can be specified for hydraulic actuator to open with trapped air to close.

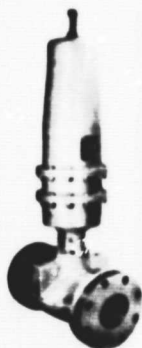
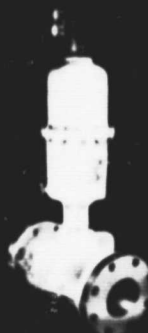
**LAF-ATO**



## **Air-to-Close, Fail-Open, with Positioner**

By combining the standard air-to-close actuator (Rollomotor) with an integrally mounted positioner, a simple but precise, totally enclosed, instrument air proportioning valve actuator, with feed back to the positioner, is achieved. Any make of side mounted positioner can be furnished with an open yoke construction as shown above.

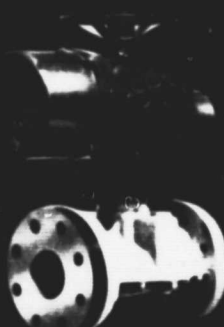
**LAF-ATCP**



## **Air-to-Open, Spring-to-Close**

This exclusive rolling diaphragm actuator (Rollomotor) is the only one available to industry to operate a pinch type valve. It is primarily for on-off service and offers the most positive fail-closed action available. Any make of side mounted positioner can be furnished with an open yoke construction as shown above.

**LAF-ATOSP**



Patented

**Slip-on Connections—Pneumatically or Hydraulically Operated—Totally Enclosed—No Moving Parts—Full Range of Elastomers for Abrasive or Corrosive Applications**



## SERIES SGE

The SGE valve is the simplest and consequently the lowest cost remotely operated pinch valve available to industry.

**OPERATION:** Operation of the SGE valve is by application of hydraulic or pneumatic pressure through the pipe connection in the housing to the annular volume surrounding the elastomeric tube. As pressure is applied the central portion of the tube collapses from opposite sides effecting centered, straight-line closure. Only straight line closure can provide gas-tight closure on slurries, gases and liquids. Upon reduction of applied pressure to atmosphere (or to vacuum if line pressure is a vacuum), the elasticity of the liner opens the valve to full-round configuration. If a vacuum condition exists in the flow line, a vacuum source, such as a vacuum generator, may be applied to the operating line to fully open the valve.

The SGE valve is generally specified for on off service, but approximate flow control (throttling) can be effected by using a PRV (pressure reducing valve) to vary the operating pneumatic or hydraulic pressure. To insure maximum cycle life, a PRV should be installed and set no higher than is necessary to close the valve tight.

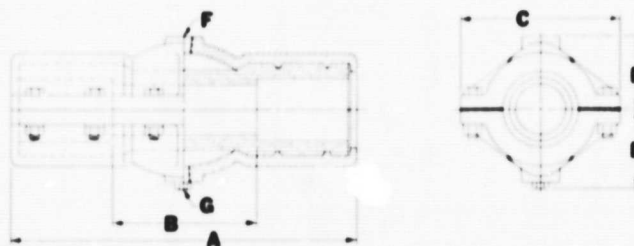
**CONSTRUCTION:** The SGE pinch valve is constructed with a split housing for easy change of elastomeric bodies, meaning less down time for maintenance. Standard housing is cast aluminum, but cast iron is available upon request. Body construction is tailored to operating conditions, and bodies are available in a wide range of elastomers including: pure gum rubber, (natural rubber), Neoprene, Buna N, Butyl, Hypalon<sup>®</sup>, Silicone, Viton<sup>®</sup>, EPDM (Nordel<sup>®</sup>) and food grade elastomers. Other elastomers available upon application.

**MAINTENANCE:** No maintenance or cleaning is necessary for the life of the valve, since there are no moving parts, no packing glands, and no seals. Length of service of the elastomeric body is dependent upon the material handled, line and operating pressures, frequency of cycling, and other factors.

**APPLICATIONS:** The SGE pinch valve is being successfully employed in air and vacuum conveying systems, handling dry powders as well as a wide range of slurries and for controlling pump discharge and hopper unloading. It can be employed in almost any aspect of pollution abatement due to its ability to close bubble tight over solid particles.

**OPTIONAL ACCESSORIES:** PRV (Pressure Reducing Valve), 3 Way Solenoid Valve, Air Pressure Gauge (Specify if installation and adjustment is desired).

**NOTE:** Air supply should be approximately 40 psig higher than line pressure in order to insure full closure of valve.



<sup>®</sup>E. I. duPont Co. trademarks

| SERIES SGE DIMENSIONS |        |        |        |         |        |        |         |        |        |        |
|-----------------------|--------|--------|--------|---------|--------|--------|---------|--------|--------|--------|
| VALVE SIZE            | 1/4    | 1/2    | 3/4    | 1       | 1-1/4  | 1-1/2  | 2       | 2-1/2  | 3      | 4      |
| A. LENGTH             | 4-1/4  | 5-3/8  | 6-1/8  | 7-3/16  | 8-1/2  | 10-1/4 | 11-3/4  | 14-1/4 | 16-1/4 | 20-1/4 |
| B. BETWEEN PIPE       | 1-5/8  | 2      | 2-1/2  | 3       | 3-1/2  | 4-1/4  | 5-1/2   | 7      | 8      | 10     |
| C. WIDTH              | 2-7/8  | 3-1/4  | 3-1/2  | 4-1/8   | 4-1/2  | 4-3/4  | 5-3/8   | 6-5/8  | 7-1/2  | 8-3/4  |
| D.                    | 1-1/16 | 1-1/4  | 1-7/16 | 1-11/16 | 2      | 2-3/16 | 2-5/8   | 3-3/16 | 3-5/8  | 4-5/8  |
| E.                    | 1-3/8  | 1-9/16 | 1-3/4  | 2       | 2-5/16 | 2-1/2  | 2-15/16 | 3-1/2  | 4      | 5      |
| F. NPT (SUPPLY)       | 1/8    | 1/8    | 1/8    | 1/4     | 1/4    | 1/4    | 1/4     | 1/4    | 1/4    | 1/4    |
| G. NPT (DRAIN)        | 1/8    | 1/8    | 1/8    | 1/4     | 1/4    | 1/4    | 1/4     | 1/4    | 1/4    | 1/4    |
| WEIGHT (ALUM.)        | 1 1/2  | 1 1/4  | 3      | 4 1/2   | 5 1/2  | 7 1/2  | 10      | 21     | 24     | 38     |
| WEIGHT (C.I.)         | 3      | 4      | 6 1/2  | 10      | 12     | 17     | 22      | 46     | 53     | 84     |

MAXIMUM PRESSURE 1/4" - 2" 50 PSIG, 3" - 4" 35 PSIG, HIGHER PRESSURE ON APPLICATION



**Flanged Connections—Short Length—Cast Iron or Aluminum Housing—Pneumatically or Hydraulically Operated—Totally Enclosed—No Moving Parts—Natural or Synthetic Rubber Body**



## SERIES SG\*

Simplicity makes the SG series pinch valve the lowest cost totally enclosed pinch valve with flanged connections available to industry.

**OPERATION:** The series SG pinch valve operates on the same principle as the SGE valve found on page 8. The SG series valve is also employed primarily in on-off service, but is capable of approximate flow control by variance of operating pressure. In all sizes and at all pressures, gas-tight closure occurs in a straight line, not a three lobe configuration.

**CONSTRUCTION:** The SG series valve differs from the SGE series only in that the elastomeric body is constructed with integrally molded 125/150 pound ANSI tapered, full-faced flanges and the housing is drilled and tapped accordingly. As with all RKL valves, the SG series valve is tailored to operating conditions in body construction and selection of elastomer. Housing is available in cast iron or aluminum. Sizes up to 24 inches.

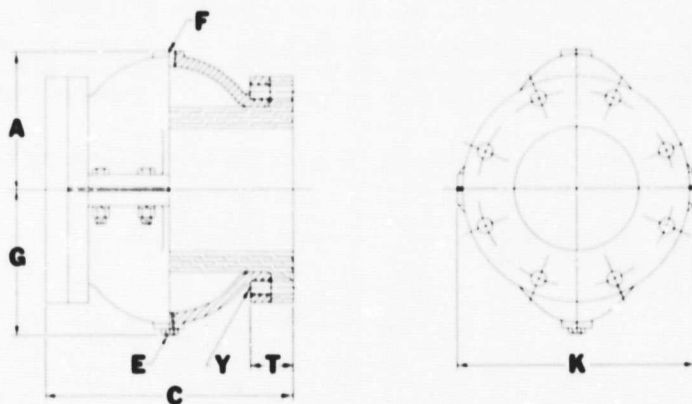
**MAINTENANCE:** As with the SGE series, absolutely no maintenance is required for the life of the valve. The split housing construction allows simple and rapid replacement of the low cost elastomeric body. With no moving parts, the housing will last indefinitely.

**APPLICATIONS:** SG pinch valves are used in any type of on-off service, particularly where abrasion or corrosion are significant factors and where extended cycle life is not of primary importance.

**OPTIONAL ACCESSORIES:** PRV (Pressure Reducing Valve), 3-way Solenoid Valve, Air Pressure Gauge (Specify if installation and adjustment is desired).

**NOTE:** AIR SUPPLY SHOULD BE APPROXIMATELY 40 PSIG HIGHER THAN LINE PRESSURE IN ORDER TO INSURE FULL CLOSURE OF THE VALVE.

\*Patented



| VALVE SIZE                      | 1      | 1-1/4  | 1-1/2  | 2      | 2-1/2  | 3      | 4      | 5      | 6      | 8      | 10     | 12     | 14     | 16     | 18      |
|---------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|
| C. INSTALLED LENGTH             | 4      | 4-5/16 | 4-3/4  | 5-1/8  | 5-3/4  | 6      | 8      | 10     | 12     | 16     | 20     | 24     | 28     | 32     | 36      |
| A. CENTERLINE TO TOP            | 2-3/4  | 2-5/8  | 3-1/4  | 3-1/4  | 3-3/4  | 4-1/4  | 5      | 5-7/8  | 7      | 8-3/4  | 10-1/2 | 11-3/4 | 13-5/8 | 15-1/4 | 16-3/8  |
| B. CENTERLINE TO BOTTOM         | 3      | 3-7/8  | 3-1/2  | 3-1/2  | 3-1/2  | 4-1/2  | 5-1/4  | 6-1/8  | 7-1/4  | 9      | 10-3/4 | 12     | 13-7/8 | 15-1/2 | 16-5/8  |
| F. AIR CONNECT. NPT             | 1/4    | 1/4    | 1/4    | 1/4    | 1/4    | 1/4    | 1/2    | 1/2    | 1/2    | 1/2    | 3/4    | 3/4    | 3/4    | 3/4    | 1       |
| C. MAIN CONNECT. NPT            | 1/4    | 1/4    | 1/4    | 1/4    | 1/4    | 1/4    | 1/4    | 1/4    | 1/4    | 1/4    | 1/4    | 1/4    | 1/4    | 1/4    | 1/4     |
| WEIGHT CAST IRON (APPROX. LBS.) | 6      | 9      | 10     | 15     | 24     | 28     | 48     | 63     | 85     | 171    | 340    | 493    | 697    | 941    | 1090    |
| WEIGHT ALUMINUM (APPROX. LBS.)  | 3      | 4      | 5      | 8      | 11     | 13     | 25     | 42     | 50     | 89     | 142    | 195    |        |        |         |
| MAX. WORKING PRESSURE PSIG      | 75     | 75     | 75     | 75     | 75     | 75     | 50     | 50     | 50     | 50     | 50     | 50     | 50     | 50     | 25      |
| V. BODY THREAD                  | 1-2-13 | 1-2-13 | 1-2-13 | 5/8-11 | 5/8-11 | 5/8-11 | 3/4-10 | 3/4-10 | 3/4-10 | 3/4-10 | 7/8-9  | 7/8-9  | 1-8    | 1-8    | 1-1/2-7 |
| V. TOTAL FLANGE THICKNESS       | 1      | 1-1/8  | 1-1/8  | 1-3/4  | 1-3/4  | 1-1/2  | 1-3/4  | 2      | 2-1/8  | 2-3/8  | 2-3/8  | 2-3/4  | 2-3/4  | 2-1/2  | 2-5/8   |
| K. WIDTH                        | 4-1/4  | 5-1/4  | 5-1/8  | 6-1/4  | 7      | 7-1/8  | 9-3/4  | 11     | 11-1/2 | 14-1/2 | 17     | 20     | 22-1/2 | 24     | 25-1/2  |

**Handwheel Operated\*—Open Construction—Enlarged Ends (Slip-on) Connections—Full Round Configuration—Indicating Limit Switches (Optional)**



## SERIES KSR

The KSR series is the only line of handwheel operated, open construction pinch valves with enlarged ends (slip-on) for installation on schedule 40 pipe, available in sizes 1/4" thru 8".

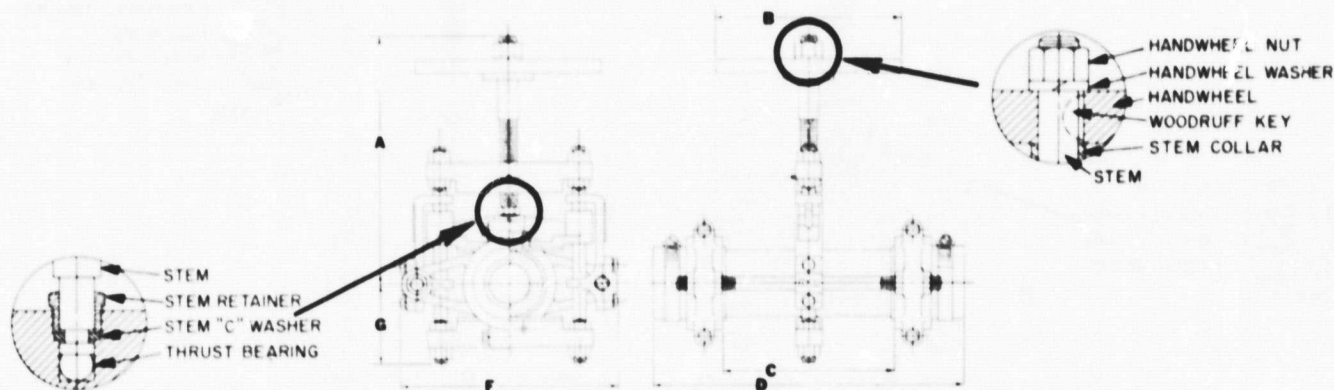
**OPERATION:** The KSR series pinch valve is operated by a handwheel which acts directly on a free floating dual pinch bar mechanism to close or open the elastomeric body. The free floating mechanism allows even closure from both sides and the patented positive opening feature (optional) insures even and complete opening since the rubber body is attached directly to the pinch bars. Closure is bubble tight and opening is full round. Overpinching of the rubber body is prevented by the positive closure stop on the stem.

**CONSTRUCTION:** All cast parts of the KSR pinch valve mechanism are of cast iron material. Stem and guide rods are 303 Stainless Steel and tie rods are cold rolled stainless steel. Mechanism is enamel painted to resist corrosion. For use in extremely corrosive atmospheres, mechanism can be epoxy coated for a small additional charge. The rubber body is available in all known elastomers to insure maximum possible life in any combination of abrasive or corrosive applications. Fully molding every body insures excellent compaction of the material and absolute uniformity in wall thickness for perfect closure. Installation of the valve is simply a matter of loosening the clamps at either end and slipping the rubber body of the valve over clean unthreaded schedule 40 pipe.

**MAINTENANCE:** Other than lubrication of the operator stem, no maintenance is required. The KSR valves are capable of extremely long cycle life, but when the rubber body finally fails, replacement is simple and inexpensive.

**APPLICATIONS:** The KSR series pinch valves are used in any number of abrasive and corrosive applications where manual control is desirable and where extremely long, trouble-free life is necessary.

**\*ALSO AVAILABLE WITH CHAIN WHEEL OPERATOR (SEE PAGE 15)**



| VALVE SIZE                 | 1/4   | 1/2   | 3/4   | 1     | 1 1/4 | 1 1/2  | 2      | 2 1/2  | 3      | 4      | 5      | 6      | 8      |
|----------------------------|-------|-------|-------|-------|-------|--------|--------|--------|--------|--------|--------|--------|--------|
| DIMEN: A CLEARANCE         | 7 1/2 | 7 1/2 | 8     | 8     | 9 1/4 | 9 1/4  | 10 1/4 | 11 1/4 | 12 1/4 | 16     | 19 1/2 | 21     | 27     |
| DIMEN: B                   | 6     | 6     | 6     | 6     | 7     | 7      | 7 1/2  | 10     | 10     | 12     | 14     | 16     | 20     |
| DIMEN: C BETWEEN PIPE      | 1-5/8 | 2     | 2     | 4     | 5     | 6      | 8      | 10     | 12     | 16     | 15     | 18     | 24     |
| DIMEN: D LENGTH            | 4 1/4 | 5     | 6     | 7 1/2 | 9 1/2 | 11 1/4 | 14     | 16     | 18 1/2 | 25 1/2 | 28 1/2 | 27 1/2 | 34 1/2 |
| DIMEN: F WIDTH             | 6 1/2 | 6 1/2 | 6 1/2 | 6 1/2 | 6 1/2 | 8 1/2  | 9      | 10     | 11     | 14     | 17     | 18     | 23     |
| DIMEN: G CLEARANCE         | 2     | 2 1/4 | 2 1/4 | 2 1/4 | 3     | 3 1/4  | 3 1/4  | 4 1/4  | 4 1/4  | 6      | 7      | 8      | 9 1/4  |
| MAX. WORKING PRESS. (PSIG) | 150   | 125   | 125   | 125   | 125   | 125    | 125    | 125    | 100    | 75     | 75     | 50     | 50     |
| WEIGHT                     | 7     | 7     | 7     | 9     | 14    | 18     | 25     | 27     | 41     | 75     | 115    | 147    | 290    |

ALL DIMENSIONS IN INCHES

149

ORIGINAL PAGE IS  
OF POOR QUALITY

**Handwheel Operated\*—Open Construction—125/150 pound ANSI Flange Connections  
—Full Round Configuration—Indicating Limit Switches (Optional)**



## SERIES KEFR

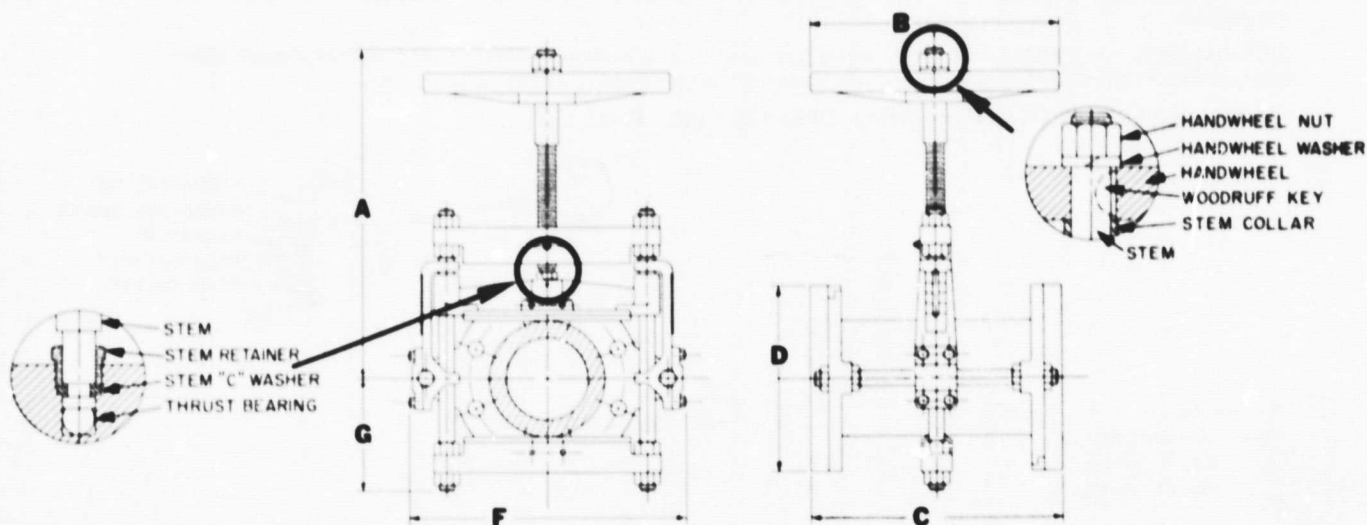
The KEFR series is the only line of full round opening pinch valves with flange connections available to industry in sizes from 1" thru 18".

**OPERATION:** The KEFR series mechanism is identical to the mechanism of the KSR series valves shown on page 10. Therefore, the KEFR series has all the advantageous operating features of the KSR series. The handwheel operator works easily for flow control or closure with no levers or brute force required. In larger sizes and at higher working pressures, a hand-operated hydraulic actuator is provided as standard equipment.

**MAINTENANCE:** Handwheel stem lubrication is the only maintenance required for the life of the valve. As with all RKL pinch valves, no cleaning is necessary. When the elastomeric body wears out, replacement is simple and inexpensive. Extremely long cycle life is characteristic of the KEFR rubber valve body.

**APPLICATIONS:** The KEFR series pinch valves are used in any number of abrasive and corrosive applications where manual control is desirable and where extremely long, trouble-free life is necessary.

**\*ALSO AVAILABLE WITH CHAIN WHEEL OPERATOR (SEE PAGE 15)**



| VALVE SIZE                 | 1     | 1½  | 2   | 2½  | 3   | 4   | 5       | 6       | 8       | 10      | 12      | 14  | 16   | 18   |
|----------------------------|-------|-----|-----|-----|-----|-----|---------|---------|---------|---------|---------|-----|------|------|
| Dimen: A Clearance         | 8     | 9½  | 10½ | 11½ | 12½ | 16  | 19½     | 21      | 27      | 32      | 37½     | 41  | 46   | 53   |
| Dimen: B                   | 6     | 7   | 7   | 10  | 10  | 12  | 14      | 16      | 20      | 24      | 24      | 28  | 32   | 40   |
| Dimen: C Installed         | 4 & 6 | 6   | 8   | 10  | 12  | 16  | 15 & 20 | 18 & 24 | 24 & 32 | 30 & 40 | 36 & 48 | 42  | 48   | 54   |
| Dimen: D                   | 4½    | 5   | 6   | 7   | 7½  | 9   | 10      | 11      | 13½     | 16      | 19      | 21  | 23½  | 26   |
| Dimen: F                   | 6½    | 8½  | 9   | 10  | 11½ | 14  | 17      | 18      | 23      | 27½     | 32      | 35½ | 42   | 48   |
| Dimen: G Clearance         | 2½    | 3½  | 3½  | 4½  | 4½  | 6   | 7       | 8       | 9½      | 10½     | 13      | 14  | 16½  | 18   |
| Max. Working Press. (PSIG) | 150   | 150 | 150 | 150 | 150 | 100 | 100     | 100     | 100     | 50      | 50      | 50  | 50   | 50   |
| Weight                     | 10    | 18  | 20  | 33  | 35  | 71  | 100     | 130     | 180     | 305     | 415     | 540 | 1133 | 1760 |

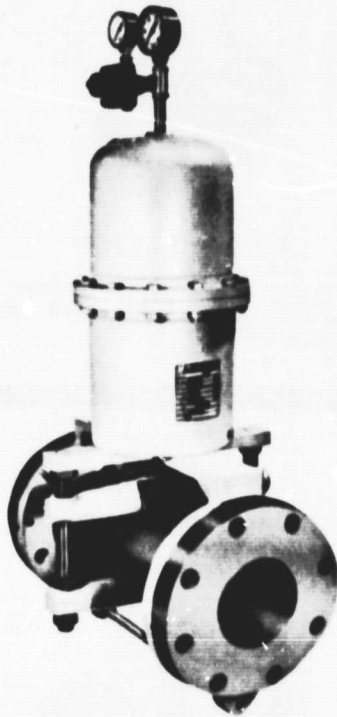
All dimensions in inches

\* Available with Bevel Gear Operator



# OPEN MECHANISM TYPES AIR AND ELECTRICALLY-OPERATED VALVES

SERIES "R" for automatic control on 125/150# ANSI flanged-or non-flanged-pipe systems



ATO\* AIR-TO-OPEN FAIL CLOSED

## THE ULTIMATE IN OPEN CONSTRUCTION PINCH VALVES

The series "R" line consists of two basic types. The flange type "RAF" and the enlarged end type "RA". Both types have open mechanisms for use where the totally enclosed series "L" is not required. They are available with all types of pneumatic or electric actuators for on-off, proportioning, floating, fail-open or fail-closed action as shown opposite on page 11.

These valves are available with aluminum and steel or cast iron and steel mechanisms. They are completely self supporting, when installed, with flow in either direction and may be mounted in any position without having to purchase special support brackets for various attitudes.

The RAF series has 125/150 pound ANSI standard flanges. As with all flanged RKL valves, the flanges of the RAF series are fully molded as an integral part of the elastomeric body (or sleeve) of the valve and have a 2° taper to improve sealing characteristics through additional compression at the inside edge. High pressure molding during vulcanization gives RKL pinch valve bodies their established reputation for quality, uniformity, and exceptional durability. RKL's patented positive opening feature is available on all series "R" valves.

The enlarged end "RA" body is of the same high quality fully molded construction and is for use on unthreaded schedule 40 pipe.

The pre-pinched design, originally developed by RKL, offers capacities within 2% of full round opening valves. Flow is streamlined across the pre pinch and no lost motion is involved for proportioning flow control as explained on page 2 under "Pre-Pinched and Full Round Types".

All pneumatic actuators are RKL Rollomotors. These rolling diaphragm actuators have the advantages of long stroke, high pneumatic working pressures for tremendous thrust, and maximum efficiency through direct actuation. These compact units provide space economy as well as monetary savings to the user. Other types and makes of actuators available upon application.



ATC—Air-To-Close (Open on air Failure)  
ATO—Air-To-Open (Close on air Failure)  
ATOSP—Air-To-Open, Spring-To-Close

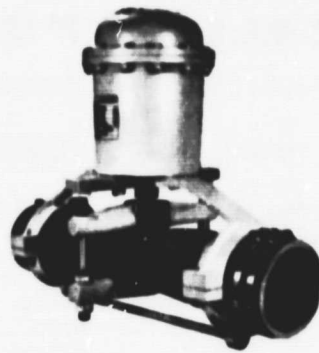
151

ATCP—Air-To-Close with Positioner  
ATOP—Air-To-Open with Positioner  
E—Electrically Operated

ADA—Double Acting

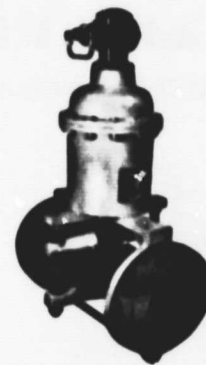
\*PATENTED





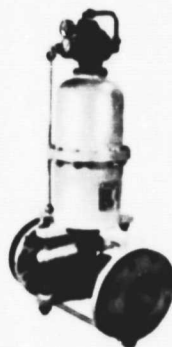
**Type RA - ATC**

Air-to-Close, Fail Open. Ideal for simple low cost in line applications. For on-off service and pressures to 100 psig.



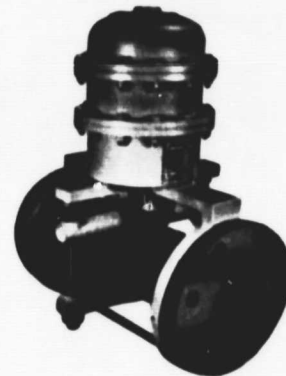
**Type RAF - ATCP**

Air-to-Close, Fail Open with Positioner. Low cost proportional flow control with positioner feedback.



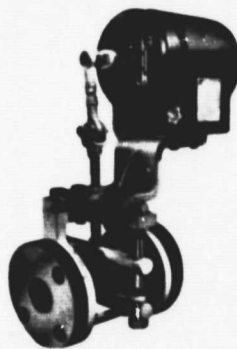
**Type RAF - ATOP\***

Air-to-Open, Fail Closed with Positioner. For proportional flow control, no external tanks needed.



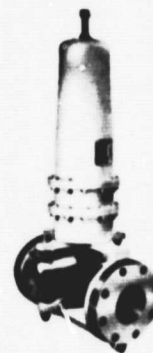
**Type RAF-ADA**

Air-to-Open, Air-to-Close, Double Acting. For fail in last position.



**Type REF**

Electrically Operated. Fail in Last Position. For on-off, flozting, or proportioning control with slidewire, 110-220 or 440 volts 60 cycles.



**Type RAF - ATOSP**

Air-to-Open, Spring-to-Close. The most positive fail closed action. Available with side mounted positioner for flow proportioning, or special dribble control.



# OPEN MECHANISM TYPES HAND LEVER OPERATED VALVES

**SERIES K® for quick-acting "on-off" service or manual flow control**

The exclusive, fully patented, hand lever operated series K valves offer the only quick acting manually operated pinch valve available to industry. The self locking cam lever passes beyond the center in the closed position so that the valve will not fly open when pressurized in this position. These valves are primarily for on-off service. However, special flow adjusting screws, located on either side of the valve, can be furnished on application to limit the valve opening so that it can always be opened to the same predetermined flow rate.

The type "KHLF" is for flanged pipe systems and is drilled to 125/150# ANSI standards.

The type "KHL" is for use with schedule 40 pipe systems and is installed simply by loosening the hose clamps and clamping bolts at each end and inserting plain unthreaded pipe and then retightening the bolts and hose clamps.

The limiting factor for line pressure is not based on the rubber or elastomeric body but on the force required to actuate the hand lever. These valves are fully self supporting and flow may be in either direction.



TYPE "KHL" HAND LEVER OPERATED VALVE  
Enlarged End (Slip-on) Connections

ORIGINAL PAGE IS  
OF POOR QUALITY

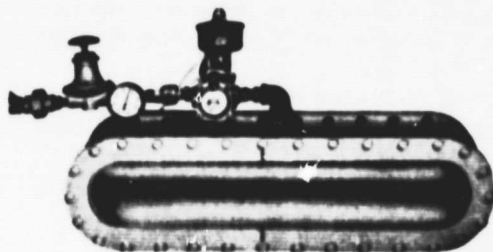


TYPE "KHLF" HAND LEVER OPERATED VALVE  
Flanged Connections



# SPECIAL PINCH VALVES

RKL Controls is noted for developing special pinch valves to fit special application. Below are listed a few of the more recent special designs, some of which are now in our product line.



**Oval Valve** --- developed to take the discharge from the full width of a conveyor belt.

**Infinitely Variable Orifice Valve**  
(with handwheel operated hydraulic actuator)  
designed for throttling service  
maintains round configuration



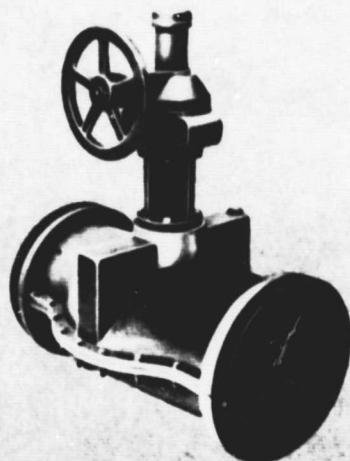
CHAIN WHEEL OPERATOR



Limit switch System

## SERIES LHW-BG BEVEL GEAR OPERATED PINCH VALVES

### LOW TORQUE MANUALLY OPERATED



LHW-BG

**PINCH VALVE OPERATION:** Turning the hand wheel activates the pinch valve stem either raising or lowering the pinch bar to fully open the valve or close air or liquid tight on grits up to 1/8".

In throttling applications the bevel gear operator controls the degree of opening without drifting when subjected to line pressure.

**PINCH VALVE CONSTRUCTION:** Cast Iron or Aluminum housing. Bevel gear operator, 303 S/S stem, mechanical stop on stem to prevent over-pinching. 125/150# or 250/300# ANSI flange connections, fully molded pinch valve elastomer body (liner). All valves are factory tested and set for your application.

**VALVE BODY MATERIALS:** Pure gum rubber, Neoprene, Hypalon, Butyl, Buna N (Nitrile), Viton, EPDM (Nordel), Silicone, FDA Rubber, O & T Butyl and Neoprene.

**APPLICATIONS:** Tailings, Milk of lime, Limestone, Wet cement, Leaching, Copper, Zinc, Fly ash and other mineral slurries, Chemical Electrolytes, Dry powders, Granular materials, Sewage sludge and many chemical applications.

- 125/150# & 250/300# ANSI FLANGES
- ALUMINUM & CAST IRON CONSTRUCTION

- ELASTOMERIC LINERS
- SIZES 4" THRU 16"

For more complete details see Bul. 675

**3-WAY DIVERTER PINCH VALVE—STANDARD 125/150 ANSI FLANGE CONNECTIONS—TOTALLY ENCLOSED—CAST IRON OR ALUMINUM HOUSING—HAND LEVER, PNEUMATIC, HYDRAULIC OR ELECTRIC OPERATOR—PARTIAL OR COMPLETE DIVERSION OF FLOW—NATURAL OR SYNTHETIC RUBBER BODY**

# 3 WAY

## \*DIVERTER PINCH VALVE

The RKL three way diverter valve was developed to serve in place of two valves used in conjunction with a "Y" fitting, while retaining all the inherent advantages of a pinch valve. As a result of this simplification, costs are lowered and space requirements significantly reduced.

**OPERATION:** The DV\* series diverter pinch valve operates by rotary actuation of a drive shaft by a hand lever, a pneumatic or hydraulic linear actuator, or an electric actuator to operate a double pinching mechanism. When either leg of the diverter valve is completely closed, the other leg will be completely open. Through use of a positioner, mixing or partial separation (depending on direction of flow) can be accomplished with capacities of the two legs being inversely proportional to one another in an even curve. As with all RKL pinch valves, the DV\* series valves are adjusted and tested to close gas tight at the maximum line pressure to be encountered in the working environment for which they are ordered. Each leg, when open, maintains full-round configuration.

**CONSTRUCTION:** The housing is composed of two halves and is available in cast iron or aluminum. The pinching mechanism is composed of cast iron and #303 stainless steel parts with Teflon and Nylar bearings. The heart of the valve is the rubber body (sleeve). The body is constructed of the highest quality elastomers (Natural or synthetic) with high tensile fabric reinforcement and is fully molded during vulcanization (including integral 125/150 pound ANSI standard flanges) to insure maximum quality and absolute uniformity. The following elastomers are available: Pure Gum Rubber (Natural Rubber), Neoprene, Hypalon<sup>1</sup>, Buna N, Butyl, Viton<sup>1</sup>, EPD (Nordel<sup>1</sup>), and Food grade elastomers including white odorless and tasteless Neoprene or Butyl and FDA rubber. Other elastomers available upon application.

RKL's patented positive opening feature is standard on all RKL DV\* series valves and replacement bodies. Position indicating limit switches are available as an accessory. Any type of actuator can be adapted to the DV\* series mechanism upon customer application. Sizes from 1½" to 10". Larger or smaller sizes upon application.

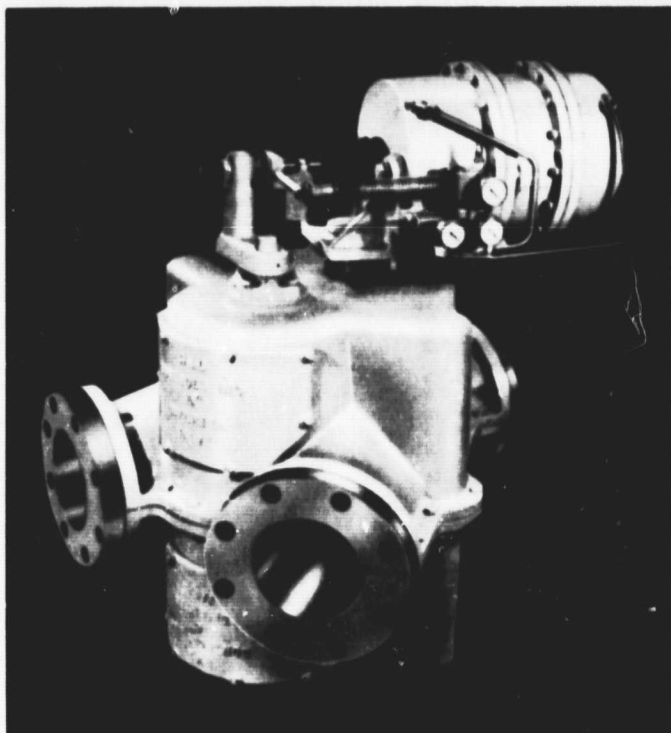
**MAINTENANCE:** Other than lubrication of the mechanism, no maintenance or cleaning is required for the life of the valve. When the rubber body wears out, replacement is simple and inexpensive.

**APPLICATIONS:** The series DV\* valve is currently being used for all sorts of slurries andveying of dry materials from cement to food. Selection of elastomers enables the valve to be matched to the application for the best possible resistance to abrasive and/or corrosive substances. The DV\* valve is especially well suited to applications of mixture or dispersal of materials. Typical applications include a constant feed system for filling bins, bags, or vats whereby one container is filled while the container in the alternate position is changed. The DV\* series valve can also be used with a positioner to introduce a substance into a closed loop, or alternatively to allow material in a closed loop to escape (continuous by-pass). The obvious advantages in the continuous by pass application are:

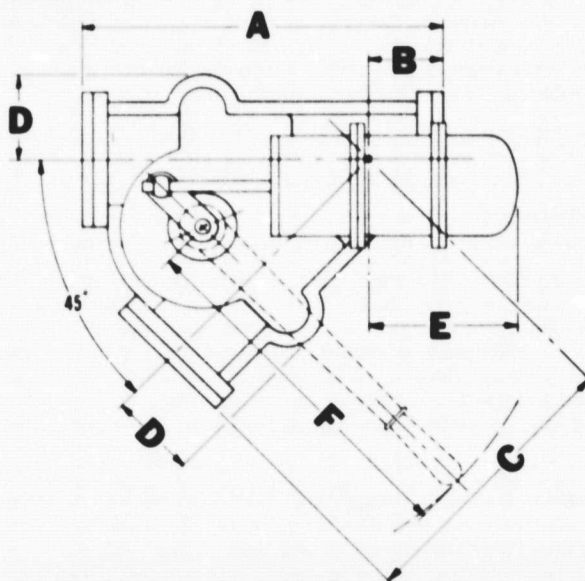
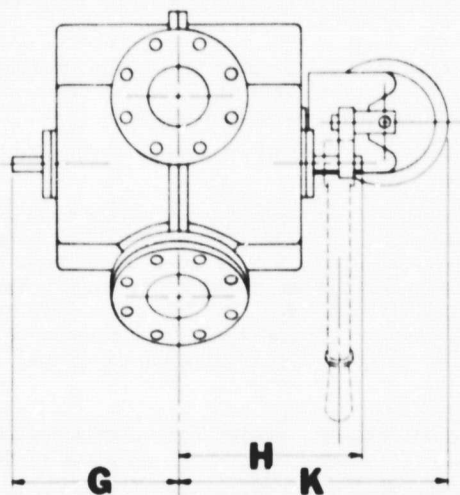
1. maintenance of velocity (to prevent precipitation of suspended solids)
2. reduction of wear through stabilization of back pressure on pump. The unique attributes of the pinch valve and the varied potential of a diverter valve are combined to make the RKL DV\* series diverter pinch valve one of the most broadly applicable valves available to industry.

\*Patented      <sup>1</sup>E. I. duPont Co. trademarks





## SERIES DV





## SIZING PROCEDURES

### STEP 1 SLURRIES CORRECTION:

- 0-7% Solids use specific gravity correction  $GPM \times K$
- 8-30% Solids multiply required GPM  $\times 1.55$
- 31-60% Solids multiply required GPM  $\times 2.00$

### STEP 2 FLOW CONTROL VALVE SIZING

Solve:  $C_v = \frac{Q_1}{\sqrt{\Delta P}}$

$Q_1$  = (GPM) Correct for Specific Gravity or Percentage Solids

$\Delta P$  = Pressure drop across valve

$\Delta P = P_1$  (MINUS)  $P_2$

$P_1$  = Pressure to inlet of valve

$P_2$  = Pressure loss downstream of valve

Pick the correct valve size from  $C_v$ 's shown below

### STEP 3 FIND PERCENTAGE OF VALVE OPEN

$\frac{\text{Calculated } C_v}{\text{Rated } C_v} = \text{Flow Factor}$

Plot Flow Factor on Flow Curve Chart

## CAPACITIES AND CONTROL VALVE

### GASES

Solve:  $C_v = \frac{Q_1}{1390 \sqrt{P \Delta P / G T}}$

$Q_1$  = capacity in cu. ft./hr.

$P$  = inlet pressure (psia)

$\Delta P$  = pressure drop across valve (psi)

$G$  = specific gravity at flowing conditions

$T$  = absolute Fahrenheit temperature ( $^{\circ}F + 460$ )

Pick the correct valve size from  $C_v$ 's shown below

### CONVERSION FACTORS

G.P.M. any liquid =  $7.47 \times 7 \text{ Cfm}$

Water = 8.35 lbs./gallon

1 Imp. (British) gallon = 1.2 U.S. gallons

$^{\circ}C = (^{\circ}F - 32) \times .556$

$^{\circ}F = ^{\circ}C \times 1.8 + 32$

Head water = psig.  $\times 2.2$

U.S. gallons in one cubic ft. = 7.48

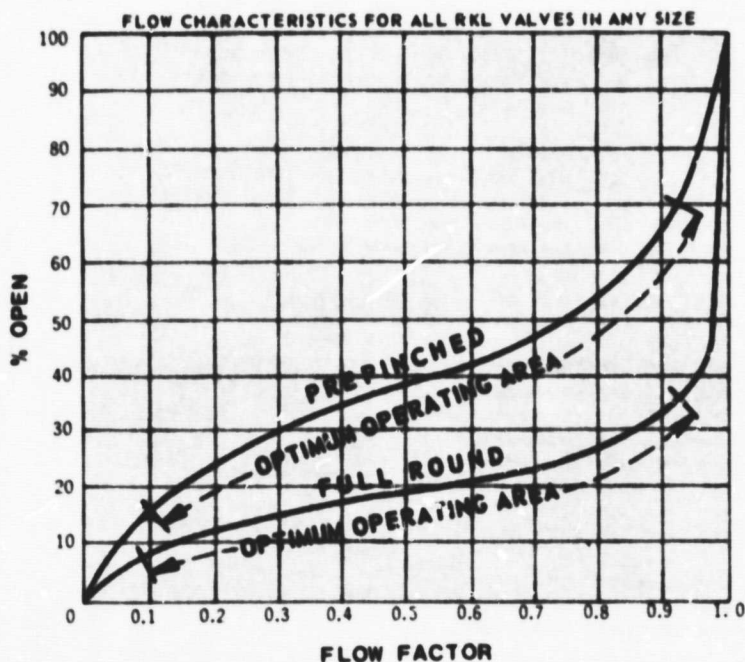
Doubling diameter of valve increases capacity 4 times at 100% open

| Valve Size | 1/4" | 1/2" | 3/4" | 1" | 1 1/4" | 1 1/2" | 2" | 2 1/2" | 3"  | 4"  | 5"  | 6"  | 8"   | 10"  | 12"  | 14"  | 16"  | 18"  | 20"  | 24"   |
|------------|------|------|------|----|--------|--------|----|--------|-----|-----|-----|-----|------|------|------|------|------|------|------|-------|
| $C_v$      | 1.3  | 5    | 12   | 21 | 33     | 47     | 83 | 130    | 187 | 332 | 519 | 747 | 1330 | 2075 | 2980 | 4150 | 5320 | 6800 | 8300 | 11920 |

### SPECIFIC GRAVITY CORRECTION FACTORS VALVE SIZING

for gases (Air = 1)  
and Liquids (Water = 1)

| Sp. Gr. | K                       | Sp. Gr. | K     | Sp. Gr. | K     |
|---------|-------------------------|---------|-------|---------|-------|
| .0692   | 3.801 (H <sub>2</sub> ) | 1.02    | 0.990 | 2.70    | 0.609 |
| .070    | 3.779                   | 1.04    | 0.981 | 2.80    | 0.598 |
| .080    | 3.535                   | 1.06    | 0.971 | 2.90    | 0.587 |
| .090    | 3.333                   | 1.08    | 0.962 | 3.00    | 0.577 |
| .100    | 3.126                   | 1.10    | 0.953 | 3.10    | 0.568 |
| .138    | 2.691 (Helium)          | 1.12    | 0.945 | 3.20    | 0.559 |
| .150    | .581                    | 1.14    | 0.937 | 3.30    | 0.550 |
| .200    | 2.240                   | 1.16    | 0.928 | 3.40    | 0.542 |
| .250    | 2.000                   | 1.18    | 0.921 | 3.50    | 0.535 |
| .300    | 1.825                   | 1.20    | 0.913 | 3.60    | 0.527 |
| .350    | 1.688                   | 1.25    | 0.895 | 3.70    | 0.520 |
| .400    | 1.580                   | 1.30    | 0.877 | 3.80    | 0.513 |
| .45     | 1.489                   | 1.35    | 0.861 | 3.90    | 0.506 |
| .50     | 1.414                   | 1.40    | 0.845 | 4.00    | 0.500 |
| .55     | 1.350                   | 1.45    | 0.830 | 4.10    | 0.494 |
| .60     | 1.290                   | 1.50    | 0.817 | 4.20    | 0.488 |
| .65     | 1.240                   | 1.55    | 0.803 | 4.30    | 0.482 |
| .70     | 1.195                   | 1.60    | 0.791 | 4.40    | 0.477 |
| .75     | 1.155                   | 1.65    | 0.779 | 4.50    | 0.472 |
| .80     | 1.117                   | 1.70    | 0.768 | 4.60    | 0.466 |
| .82     | 1.104                   | 1.75    | 0.756 | 4.70    | 0.461 |
| .84     | 1.091                   | 1.80    | 0.745 | 4.80    | 0.455 |
| .86     | 1.078                   | 1.90    | 0.725 | 4.90    | 0.452 |
| .88     | 1.066                   | 2.00    | 0.707 | 5.00    | 0.447 |
| .90     | 1.055                   | 2.10    | 0.690 |         |       |
| .92     | 1.043                   | 2.20    | 0.674 |         |       |
| .94     | 1.031                   | 2.30    | 0.659 |         |       |
| .96     | 1.021                   | 2.40    | 0.645 |         |       |
| .98     | 1.010                   | 2.50    | 0.633 |         |       |
| 1.00    | 1.000                   | 2.60    | 0.620 |         |       |



# SIZING INFORMATION

## APPLICATIONS

### QUICK REFERENCE FOR SIZING ONLY

(Not to be used to determine  $\Delta P$  thru a pinch valve controlling flow)

STEP 1 CORRECT GPM FOR SPECIFIC GRAVITY OR PERCENTAGE SOLIDS

STEP 2 DETERMINE  $\Delta P = P_1$  (MINUS)  $P_2$

STEP 3 ENTER  $\Delta P$  UNDER  $\Delta P$  PSI COLUMN

STEP 4 READ ACROSS TO THE FIRST VOLUME WHICH EXCEEDS THE GPM DETERMINED IN STEP 1

STEP 5 READ UP TO THE VALVE SIZE

EXAMPLE: CORRECTED GPM=630  $\Delta P=4$  PSI SIZE 4" VALVE

$P_1$  (MINUS)  $P_2$

$\Delta P$

VALVE SIZE

| PSI | 1/4" | 1/2" | 3/4" | 1"  | 1-1/4" | 1-1/2" | 2"   | 2-1/2" | 3"   | 4"   | 5"   | 6"    | 8"    | 10"   | 12"   | 14"   | 16"   | 18"   | 20"   | 24"   |
|-----|------|------|------|-----|--------|--------|------|--------|------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1   | 1.3  | 5    | 12   | 21  | 33     | 47     | 63   | 130    | 187  | 332  | 519  | 747   | 1330  | 2075  | 2980  | 4150  | 5320  | 6800  | 8300  | 11880 |
| 2   | 1.7  | 7    | 16   | 29  | 46     | 66     | 117  | 183    | 284  | 468  | 723  | 1052  | 1850  | 2825  | 4200  | 5850  | 7520  | 9530  | 11720 | 16870 |
| 3   | 2.2  | 9    | 20   | 36  | 56     | 81     | 144  | 225    | 324  | 574  | 890  | 1291  | 2300  | 3680  | 5150  | 7180  | 9170  | 11760 | 14380 | 20880 |
| 4   | 2.5  | 10   | 23   | 42  | 65     | 94     | 168  | 260    | 374  | 664  | 1030 | 1485  | 2640  | 4150  | 5880  | 8020  | 10610 | 13590 | 16880 | 23840 |
| 5   | 2.8  | 12   | 26   | 46  | 73     | 105    | 195  | 291    | 418  | 744  | 1160 | 1672  | 2980  | 4650  | 6680  | 9270  | 11880 | 15200 | 18540 | 26880 |
| 6   | 3.1  | 13   | 29   | 51  | 80     | 115    | 208  | 318    | 448  | 813  | 1270 | 1830  | 3260  | 5080  | 7300  | 10150 | 12980 | 16620 | 20300 | 28220 |
| 7   | 3.3  | 14   | 31   | 56  | 86     | 125    | 220  | 342    | 496  | 880  | 1365 | 1980  | 3525  | 5500  | 7800  | 10850 | 14010 | 17980 | 21880 | 31080 |
| 8   | 3.5  | 15   | 33   | 59  | 92     | 132    | 235  | 368    | 529  | 940  | 1460 | 2115  | 3765  | 5870  | 8440  | 11720 | 14990 | 19230 | 23460 | 33710 |
| 9   | 3.7  | 16   | 35   | 62  | 98     | 140    | 249  | 390    | 564  | 995  | 1540 | 2240  | 3980  | 6225  | 8940  | 12430 | 15920 | 20420 | 24900 | 35820 |
| 10  | 3.9  | 17   | 37   | 66  | 103    | 147    | 261  | 411    | 588  | 1045 | 1620 | 2360  | 4200  | 6550  | 9420  | 13110 | 16780 | 21480 | 26250 | 37680 |
| 15  | 4.8  | 20   | 45   | 80  | 126    | 181    | 321  | 503    | 724  | 1285 | 2005 | 2880  | 5150  | 8025  | 11500 | 16060 | 20580 | 26300 | 32100 | 48150 |
| 20  | 5.5  | 23   | 52   | 93  | 145    | 209    | 371  | 581    | 835  | 1485 | 2300 | 3340  | 5950  | 9275  | 13300 | 18540 | 23750 | 30210 | 37080 | 53880 |
| 25  | 6.2  | 26   | 59   | 104 | 163    | 234    | 415  | 650    | 935  | 1680 | 2660 | 3735  | 6850  | 10350 | 14900 | 20720 | 26520 | 33940 | 41430 | 59880 |
| 30  | 6.8  | 28   | 64   | 114 | 178    | 256    | 454  | 713    | 1025 | 1820 | 2840 | 4085  | 7280  | 11350 | 16300 | 22700 | 29080 | 37200 | 45420 | 62580 |
| 35  | 7.4  | 31   | 69   | 123 | 192    | 277    | 493  | 770    | 1108 | 1970 | 3070 | 4425  | 7880  | 12290 | 17600 | 24520 | 31380 | 40190 | 49080 | 70680 |
| 40  | 7.9  | 33   | 74   | 131 | 208    | 296    | 525  | 823    | 1182 | 2130 | 3280 | 4725  | 8410  | 13100 | 18800 | 26210 | 33600 | 42980 | 52480 | 75500 |
| 45  | 8.4  | 35   | 79   | 139 | 218    | 314    | 557  | 873    | 1255 | 2230 | 3470 | 5100  | 8930  | 13900 | 20000 | 27820 | 35600 | 45600 | 55610 | 80100 |
| 50  | 8.8  | 37   | 83   | 147 | 230    | 330    | 587  | 920    | 1322 | 2345 | 3660 | 5285  | 9420  | 14680 | 21000 | 29350 | 37510 | 48080 | 58900 | 84380 |
| 55  | 9.2  | 38   | 87   | 154 | 241    | 347    | 616  | 935    | 1388 | 2465 | 3850 | 5645  | 9880  | 15380 | 22000 | 30600 | 39080 | 50380 |       |       |
| 60  | 9.6  | 40   | 91   | 161 | 252    | 362    | 643  | 1009   | 1450 | 2570 | 4015 | 5780  | 10310 | 16090 | 23200 | 32100 | 41100 | 52610 |       |       |
| 65  | 10.0 | 42   | 94   | 167 | 262    | 377    | 669  | 1050   | 1508 | 2675 | 4180 | 6020  | 10830 | 16880 | 23800 | 33410 | 42810 | 54750 |       |       |
| 70  | 10.4 | 43   | 98   | 174 | 272    | 391    | 695  | 1090   | 1565 | 2780 | 4335 | 6230  | 11100 | 17310 | 24900 | 34700 | 44480 | 56880 |       |       |
| 75  | 10.8 | 45   | 101  | 180 | 282    | 405    | 720  | 1125   | 1620 | 2875 | 4470 | 6470  | 11510 | 17860 | 25600 | 35900 | 46080 | 58750 |       |       |
| 80  | 11.2 | 46   | 105  | 186 | 290    | 418    | 741  | 1160   | 1670 | 2980 | 4630 | 6680  | 11800 | 18520 | 26650 | 37100 | 47510 | 60810 |       |       |
| 85  | 11.5 | 48   | 108  | 191 | 300    | 431    | 765  | 1200   | 1730 | 3080 | 4780 | 6910  | 12300 | 19210 | 27450 | 38300 | 48980 | 62670 |       |       |
| 90  | 11.8 | 49   | 111  | 197 | 308    | 443    | 787  | 1231   | 1780 | 3150 | 4920 | 7100  | 12650 | 19700 | 28250 | 39350 | 50400 | 64450 |       |       |
| 95  | 12.2 | 51   | 114  | 202 | 317    | 456    | 810  | 1268   | 1825 | 3250 | 5080 | 7280  | 12950 | 20210 | 29010 | 40400 | 51710 | 66280 |       |       |
| 100 | 12.5 | 52   | 117  | 208 | 325    | 467    | 830  | 1300   | 1870 | 3330 | 5180 | 7450  | 13280 | 20750 | 29800 | 41500 | 53200 | 68100 |       |       |
| 110 | 13.1 | 53   | 123  | 218 | 350    | 490    | 870  | 1360   | 1980 | 3490 | 5430 | 7850  | 13900 | 21750 | 31230 | 43500 |       |       |       |       |
| 120 | 13.7 | 55   | 131  | 228 | 366    | 512    | 910  | 1420   | 2050 | 3640 | 5680 | 8150  | 14500 | 22720 | 32600 | 45400 |       |       |       |       |
| 130 | 14.2 | 57   | 137  | 237 | 380    | 532    | 945  | 1475   | 2130 | 3780 | 5820 | 8530  | 15170 | 23650 | 33980 | 47300 |       |       |       |       |
| 140 | 14.8 | 59   | 142  | 246 | 394    | 551    | 980  | 1530   | 2210 | 3920 | 6140 | 8850  | 15710 | 24550 | 35250 | 49100 |       |       |       |       |
| 150 | 15.3 | 61   | 147  | 254 | 407    | 570    | 1010 | 1580   | 2280 | 4050 | 6340 | 9150  | 16300 | 25400 | 36600 | 50700 |       |       |       |       |
| 160 | 15.8 | 63   | 152  | 262 | 418    | 584    | 1050 | 1640   | 2365 | 4200 | 6560 | 9450  | 16820 |       |       |       |       |       |       |       |
| 170 | 15.3 | 65   | 156  | 270 | 430    | 613    | 1080 | 1680   | 2440 | 4330 | 6760 | 9740  | 17320 |       |       |       |       |       |       |       |
| 180 | 16.8 | 67   | 161  | 278 | 443    | 631    | 1110 | 1745   | 2510 | 4450 | 6980 | 10050 | 17850 |       |       |       |       |       |       |       |
| 190 | 17.2 | 69   | 165  | 286 | 454    | 648    | 1145 | 1790   | 2575 | 4570 | 7140 | 10300 | 18450 |       |       |       |       |       |       |       |
| 200 | 17.7 | 71   | 169  | 293 | 466    | 664    | 1172 | 1835   | 2645 | 4690 | 7340 | 10550 | 18800 |       |       |       |       |       |       |       |
| 210 | 18.1 | 73   | 174  | 304 | 478    | 682    | 1201 | 1883   | 2710 | 4810 | 7530 | 10830 | 19250 |       |       |       |       |       |       |       |
| 220 | 18.5 | 74   | 177  | 311 | 485    | 697    | 1230 | 1920   | 2775 | 4920 | 7680 | 11070 | 19750 |       |       |       |       |       |       |       |
| 230 | 18.9 | 76   | 182  | 318 | 506    | 714    | 1257 | 1975   | 2835 | 5030 | 7870 | 11320 | 20150 |       |       |       |       |       |       |       |
| 240 | 19.4 | 78   | 186  | 325 | 512    | 728    | 1285 | 2013   | 2898 | 5140 | 8036 | 11570 | 20600 |       |       |       |       |       |       |       |
| 250 | 19.6 | 79   | 189  | 332 | 522    | 744    | 1310 | 2055   | 2955 | 5250 | 8220 | 11720 | 21200 |       |       |       |       |       |       |       |
| 260 | 20.1 | 80   | 193  | 338 |        |        |      |        |      |      |      |       |       |       |       |       |       |       |       |       |
| 270 | 20.5 | 82   | 197  | 345 |        |        |      |        |      |      |      |       |       |       |       |       |       |       |       |       |
| 280 | 20.9 | 84   | 210  | 351 |        |        |      |        |      |      |      |       |       |       |       |       |       |       |       |       |



## CHEMICAL RESISTANCE CHARTS

**RKL Controls has been a leader in developing special compounds of standard rubbers and elastomers for use specifically in pinch type valves. We were the first to use a Hypalon, Viton, and Silicone compound in standard pinch valve bodies.**

The object in developing a compound for high abrasion resistance is to maintain as high a tensile strength as possible with as low a durometer (softness) as possible. A slurry particle flowing in a line will then bounce off the internal surface of the pinch valve body without cutting the rubber or elastomer. Standard friction abrasion tests cannot be used to measure abrasive impingement wear, as occurs in a pinch valve. Highly loading a rubber or elastomer, to decrease its cost, only increases its durometer and its resistance to closure as well as decreasing its resistance to impingement type abrasion.

The object in developing a compound for high chemical resistance is to pick the most highly resistant elastomer and develop a formulation which does not lose its chemical resistance as extenders, curing agents, and fillers are added. It also must be kept in mind that a low durometer offers the best seal on closure with the least amount of force required to close and that a high tensile strength will offer longer life of the elastomer as it is stretched and stressed upon closure of the pinch valve.

RKL has developed all their compounds with the above parameters in mind and believes it has the best compounds, with the broadest range available to industry.

The data listed below is meant only as a guide. When a question, borderline case or a chemical is not listed, our factory should be consulted. We will be glad to furnish test slabs of various compounds for evaluation in your own laboratories.

**S-satisfactory**

**D-doubtful**

**U-not recommended**

**E-fair**

**BLANK-no experience**

| S-satisfactory                 | NATURAL RUBBER     | BRUN-A-S (SBR) | BUTYL (BRUN-B) | NEOPRENE  | HYTALON | SILICONE | EPDM | HEP-CAR |
|--------------------------------|--------------------|----------------|----------------|-----------|---------|----------|------|---------|
| D-doubtful                     |                    |                |                |           |         |          |      |         |
| U-not recommended              |                    |                |                |           |         |          |      |         |
| F-fair                         |                    |                |                |           |         |          |      |         |
| BLANK-no experience            |                    |                |                |           |         |          |      |         |
| Acetic Acid-Vapors             | F                  | F/S            | S              | F/SF/S    | S       | S        | S    | S       |
| Acetamide                      | F/DF/D             | S              | F              | F         | S       | S        | S    | S       |
| Acetic Acid(Crude or Pure)     | F                  | F/S            | F              | S         | F       | S        | S    | S       |
| Acetic Acid, Hot High Pressure | U                  | U              | F              | SD/UD     | U       | F        | S    | S       |
| Acetic Acid, 30%               | D                  | F/D            | S              | S         | S       | S        | S    | S       |
| Acetic Acid, Glacial           | D                  | F/S            | F              | U         | D       | F        | S    | F       |
| Acetic Anhydride               | S                  | F/SF/SF/S      | S              | S         | F/D     | S        | F    | S       |
| Acetone                        | F/SF/S             | S              | U              | F/SF/S    | S       | S        | U    | S       |
| Acetylene                      | S                  | S              | S              | F/SF/SF/D | S       | S        | S    | S       |
| Acrylonitrile                  | S                  | U              | F              | U         | S       | F/S      | S    | U       |
| Air 200°F                      | S                  | S              | S              | S         | S       | S        | S    | S       |
| Alkane                         | S                  | S              | S              | S         | S       | F/S      | S    | S       |
| Alum                           | S                  | S              | S              | S         | S       | S        | S    | S       |
| Aluminum Acetate               | S                  | S              | S              | S         | S       | S        | U    | F       |
| Aluminum Ch. Oxide             | S                  | S              | S              | S         | F/S     | S        | S    | S       |
| Aluminum Fluoride              | S                  | S              | S              | S         | F/S     | S        | S    | S       |
| Aluminum Nitrate               | S                  | S              | S              | S         | S       | F/S      | S    | S       |
| Aluminum Sulfate               | S                  | S              | S              | S         | S       | S        | S    | S       |
| Alumina Mixed                  | S                  | S              | F              | F/SF/S    | F       | U        | S    | S       |
| Ammonia Anhydrous              | S                  | S              | S              | F/D       | S       | U        | S    | S       |
| Ammonia Gas Mix                | F/DF/DF/SF/DF/SF/S | S              | S              | S         | S       | S        | U    | U       |
| Ammonia Liquid                 | F/DF/D             | S              | F/SF/DF/D      | S         | S       | U        | S    | U       |
| Ammonia Carbonate              | S                  | S              | U              | F         | F/S     | S        | S    | S       |
| Ammonia Chloride               | S                  | S              | S              | S         | S       | F/S      | S    | S       |
| Ammonium Hydroxide             | F/SF/S             | S              | F/S            | S         | S       | S        | S    | U       |
| Ammonium Nitrate               | S                  | S              | D              | S         | F       | S        | S    | S       |
| Ammonium Perfluoride           | S                  | S              | S              | S         | S       | S        | S    | S       |
| Ammonium Phosphate             | S                  | S              | S              | S         | S       | S        | S    | S       |
| Ammonium Mono-Di-Tri           | S                  | S              | S              | S         | S       | S        | S    | S       |
| Ammonium Sulfate               | S                  | S              | S              | S         | S       | S        | S    | S       |
| Ammonium Thiocyanate           | S                  | S              | S              | S         | S       | S        | S    | S       |
| Amyl Acetate                   | F/D                | U              | F/D            | U         | U       | D/W/S    | S    | F       |
| Amyl Alcohol                   | S                  | S              | S              | S         | S       | D/U      | S    | S       |
| Amyl Borate                    | U                  | U              | S              | S         | S       | S        | S    | S       |
| Amyl Chloronaphthalene         | U                  | U              | U              | S         | D       | S        | S    | S       |
| Aniline                        | S                  | F/SF/S         | U              | F/D       | F       | S        | F/S  | U       |
| Aniline Hydrochloride          | U                  | F/SF/S         | F              | F         | F       | U        | S    | S       |
| Animal Oil (Lard Oil)          | U                  | S              | S              | S         | D       | S        | S    | U       |
| Aqua Regia (Conc.)             | D                  | D              | F              | U         | D       | F/D      | S    | U       |
| Arsenic Acid                   | S                  | S              | S              | S         | S       | S        | S    | S       |
| Asphalt                        | U                  | U              | U              | F/S       | F       | F/S      | S    | S       |
| Barium Chloride                | S                  | S              | S              | S         | S       | S        | S    | S       |
| Barium Hydroxide               | S                  | S              | S              | S         | S       | S        | S    | S       |
| Barium Sulfate                 | S                  | S              | S              | S         | S       | D/S      | S    | S       |
| Barium Sulfide                 | S                  | S              | S              | S         | S       | F/S      | S    | S       |
| Beer                           | S                  | S              | S              | F/DF/S    | S       | S        | S    | S       |
| Beet Sugar Liquors             | S                  | S              | S              | S         | S       | S        | S    | S       |
| Benzene Benzol                 | U                  | U              | F/D            | U         | U       | D/U      | U    | U       |
| Benzene                        | U                  | S              | U              | S         | U       | D/U      | S    | U       |
| Benzaldehyde                   | D/U                | U              | S              | U         | U       | S        | D    | F       |
| Benzyl Alcohol                 | S                  | F              | S              | U         | F       | S        | U    | U       |
| Benzyl Benzoate                | F/D                | U              | S              | U         | U       | S        | U    | U       |
| Benzyl Chloride                | F/D                | D              | S              | U         | U       | S        | D    | U       |
| Black Sulfate Liq.             | S                  | S              | S              | S         | S       | S        | S    | S       |
| Blast Furn., Gas               | F/D/DF/D           | F              | F              | S         | S       | S        | S    | S       |
| Borax                          | S                  | S              | S              | S         | S       | S        | S    | S       |
| Boric Acid                     | S                  | S              | S              | S         | S       | F/S      | S    | S       |
| Bordeaux                       | S                  | S              | S              | S         | S       | S        | S    | S       |
| Boron Fuels (REF)              | S                  | S              | S              | S         | S       | S        | S    | S       |
| Brake Fluid (Veg.)             | S                  | S              | S              | S         | S       | S        | S    | U       |
| Bromine                        | U                  | U              | U              | U         | D       | S        | D    | U       |
| Bunker Oil                     | U                  | U              | U              | S         | S       | F        | S    | S       |
| Butane                         | U                  | U              | D              | F/SF/SF/S | S       | F        | S    | S       |
| Butyl Acetate                  | U                  | U              | U              | U         | U       | F/S      | U    | U       |
| Butyl Acryl Ricinoleate        | S                  | S              | S              | F/D       | U       | D        | F/S  | U       |
| Butyl Alcohol, Butane X        | D                  | S              | S              | S         | S       | F        | S    | S       |
| Butyl Amine                    | F/D                | S              | U              | D         | S       | F/S      | U    | U       |
| Butyl Carbitol                 | S                  | S              | S              | S         | S       | S        | U    | U       |
| Calcium Acetate                | S                  | S              | S              | S         | S       | S        | U    | S       |
| Calcium Sulfite                | S                  | S              | S              | S         | S       | F        | S    | S       |
| Calcium Chloride               | S                  | S              | S              | S         | S       | S        | S    | S       |
| Calcium Hydroxide              | S                  | S              | S              | S         | S       | S        | S    | S       |
| Calcium Hypochlorite           | S                  | S              | S              | F         | S/T     | S        | S    | F       |
| Calcium Nitrate                | S                  | S              | S              | S         | S       | S        | S    | S       |
| Calcium Sulfide                | S                  | S              | S              | S         | S       | S        | S    | F       |
| Calcium Sulfate                | S                  | S              | S              | S         | S       | S        | S    | S       |
| Calcium Tetrachloride          | U                  | U              | U              | F/D       | U       | S        | D    | F       |
| Cellulose                      | F                  | F/S            | S              | S         | S       | S        | S    | S       |
| Cellulose, Acetate             | U                  | U              | U              | U         | U       | U        | U    | U       |
| Cellulose, Butyl               | S                  | S              | S              | S         | S       | S        | S    | S       |
| Chlorine Dioxide               | S                  | S              | S              | S         | S       | S        | S    | S       |
| Chlorine Trifluoride           | S                  | S              | S              | S         | S       | S        | S    | S       |
| Chlorinated Salt Brine         | S                  | S              | S              | S         | S       | S        | S    | S       |
| Chlorinated Solvents           | U                  | U              | U              | S/U       | U       | U        | S    | F       |
| Chloroacetone                  | S                  | S              | S              | S         | S       | S        | S    | S       |
| Chloroacetic Acid              | S                  | S              | S              | S         | S       | S        | S    | S       |
| Chloroacetylene                | U                  | U              | U              | U         | U       | U        | U    | U       |
| Chlorobromomethane             | U                  | U              | U              | U         | U       | U        | U    | U       |
| Chlorobutadiene                | U                  | U              | U              | U         | U       | U        | U    | U       |
| Chloroform                     | U                  | U              | U              | U         | U       | U        | U    | U       |
| o-Chloronaphthalene            | U                  | U              | U              | U         | U       | U        | U    | U       |
| 1-Chloro Nitro Ethane          | U                  | U              | U              | U         | U       | U        | F    | U       |
| Chlorosulfonic Acid            | U                  | U              | U              | U         | U       | U        | U    | U       |
| Chlorox                        | U                  | U              | U              | U         | U       | U        | U    | U       |
| Chromic Etching Solution       | S                  | S              | S              | S         | S       | S        | S    | S       |
| Chromic Acid                   | U                  | U              | F/S            | U         | S       | F/S      | S    | U       |
| Citric Acid                    | S                  | S              | S              | S         | S       | S        | S    | S       |
| Citric Light Process Oil       | U                  | U              | D              | S         | S       | F/D      | S    | S       |
| Coke Oven Gas                  | D                  | D              | D              | F/DF/D    | S       | S        | S    | S       |
| Copper Chloride                | S                  | S              | S              | S         | S       | S        | S    | S       |
| Copper Cyanide                 | S                  | S              | S              | S         | S       | S        | S    | S       |
| Copper Sulfate                 | S                  | S              | S              | S         | S       | S        | S    | S       |
| Corn Oil                       | U                  | U              | S              | F/D       | F       | F/D      | S    | S       |
| Cottonseed Oil                 | U                  | U              | S              | F         | F/DF/S  | S        | S/F  | S       |
| Cresosol(Wood or Coal Tar)     | U                  | U              | S              | S         | F       | D        | F/D  | D       |
| Cresol, Cresylic Acid          | D/U                | U              | D/UD           | U         | D       | F/D      | S    | U       |
| Cyclo Hexane                   | U                  | U              | U              | S         | F/D     | S        | D    | S       |
| Cyclohexanone                  | U                  | U              | U              | U         | U       | U        | U    | U       |
| Cyclohexanone                  | U                  | U              | U              | U         | U       | U        | U    | U       |
| Denatured Alcohol              | S                  | S              | S              | S         | S       | S        | S    | S       |
| Developing Solutions (Hypo)    | S                  | S              | F/S            | S         | S       | S        | S    | S       |
| Dibenzyl Ether                 | U                  | U              | S              | U         | U       | U        | U    | U       |
| Dibutylamine                   | S                  | S              | S              | U         | U       | S        | S    | U       |
| Dibutyl Ether                  | S                  | S              | F/S            | D         | U       | U        | S    | F       |
| Diethyl Phthalate              | U                  | U              | F/D            | U         | U       | D        | S    | F       |
| Diethylchloromethane           | U                  | U              | U              | F/D       | U       | D/U      | S    | U       |
| Diethylhexylamine              | U                  | U              | U              | F/S       | U       | F/S      | U    | U       |
| Diethylamine                   | S                  | S              | S              | F/S       | S       | S        | S    | U       |
| Diethylene, Glycol             | S                  | S              | S              | S         | S       | S        | S    | S       |
| Diethylether                   | U                  | U              | F              | S         | F       | F/U      | S    | S       |
| Diethyl Sebacate               | S                  | S              | U              | U         | F/D     | S        | F    | U       |
| Di-isopropyl Ketone            | D                  | D              | F/S            | U         | U       | F/S      | F    | F       |
| Dimethyl Aniline               | S                  | U              | U              | S         | U       | S        | S    | S       |
| Dimethyl Formamide             | S                  | S              | F/D            | S         | U       | F/S      | U    | U       |
| Dimethyl Toluene               | S                  | S              | S              | S         | S       | S        | S    | U       |
| Diocetyl Phthalate             | U                  | U              | S              | F/S       | U       | D        | S    | F       |
| Diocetyl Sebacate              | U                  | U              | S              | S         | S       | S        | D/F  | S       |
| Dioxane                        | U                  | U              | S              | U         | U       | U        | S    | U       |
| Dipentene                      | U                  | U              | U              | F/S       | U       | U        | S    | S       |
| Diphenyl                       | U                  | U              | U              | U         | U       | U        | S    | S       |
| Diphenyl Oxides                | U                  | U              | U              | U         | D       | F/S      | S    | U       |
| Epichlorohydrine               | U                  | U              | U              | U         | U       | U        | F    | U       |
| Ethanolamine                   | S                  | S              | S              | S         | F/S     | S        | S    | F/S     |
| Ethers                         | F                  | F              | F              | F         | F/S     | S        | S    | S       |
| Ethyl Acetate                  | D/UD               | U              | S              | D/U       | U       | F/S      | U    | S       |
| Ethyl Acrylate                 | S                  | S              | S              | S         | S       | S        | S    | U       |
| Ethyl Alcohol                  | S                  | S              | S              | S         | S       | S        | S    | S       |
| Ethyl Benzene                  | U                  | U              | U              | U         | U       | U        | S    | S       |
| Ethyl Cellulose                | F/SF/S             | F              | F/SF/S         | F         | F       | F        | S    | S       |
| Ethyl Chloride                 | S                  | F/S            | S              | F/SF/S    | U       | D        | S    | F       |
| Ethylene Diamine               | S                  | F/S            | S              | S         | S       | S        | S    | S       |

Ethylene Dichloride  
Ethylene Oxide  
Ethylene Glycol  
Ethyl Ether  
Ethyl Mercaptan  
Ethyl Oxalate  
Ethyl Pentachlorobenzene  
Ethyl Silicate  
Fatty Acids  
Ferric Chloride  
Ferric Nitrate  
Ferric & Ferrous Sulfate  
Fluoboric Acid  
Fluoboric Acid  
Fluoric Acid (liquid)  
Fluorobenzene  
Fluorobenzotrifluoride  
Fluorobenzyl Ether  
Fluoroboric Acid  
Formaldehyde  
Formic Acid  
Freon 11  
Freon 12  
Freon 21  
Freon 22  
Freon 113  
Freon 114  
Fuel Oil Acidic  
Fumaric Acid  
Furfural  
Gallic Acid  
Gasoline  
Gelatin  
Glauber's Salt  
Glucose  
Gluce  
Glycerin  
Glyonic  
Green Sulfate Liqueur  
n-Hexaldehyde  
Hexane  
Nonyl Alcohol  
High Energy Fuels  
Hydraulic Oil  
Hydrobromic Acid  
Hydrochloric Acid (cold)  
Hydrochloric Acid (hot)  
Hydrochloric Acid 37%  
Hydrocyanic Acid  
Hydrofluoric Acid 48%  
Hydrofluoric Acid 70%  
Hydrofluoric Acid Anhydrous  
Hydrofluosulfuric Acid  
Hydrogen  
Hydrogen Peroxide  
Hydrogen Peroxide 90%  
Hydrogen Sulfide  
Hydroxybenzoic Acid  
Isobutyl Alcohol  
Isooctane  
Isopropyl Acetate  
Isopropyl Alcohol  
Isopropyl Chloride  
Isopropyl Ether  
JP-1 to JP-6 fuels  
JP-X  
Kerosene  
Lacquers  
Lacquer Solvents  
Lard  
Lead Acetate  
Lead Nitrate  
Lead Sulfate  
Liquefied Petroleum Gas  
Liquid Oxygen  
Lubricating Oil  
Magnesium Chloride  
Magnesium Hydrosulfide  
Magnesium Sulfate  
Maleic Acid  
Malic Acid  
Mercuric Chloride  
Mercury  
Mercury Vapor  
Methyl Acetate  
Methyl Acrylate  
Methyl Butyl Ketone  
Methyl Chloride  
Methyl Ethyl Ketone  
Methyl Isobutyl Ketone  
Methyl Isopropyl Ketone  
Methyl Methacrylate  
Methyl Salicylate  
Methylene Dichloride  
Milk  
Mineral Oil  
Monobromo Benzene  
Monochloro Benzene  
Mono Ethanolamine  
Naptha  
Naphthalene  
Natural Gas  
Nickel Acetate  
Nickel Chloride  
Nickel Sulfate  
Nitric Acid Conc.  
Nitric Acid Dilute  
Nitric Acid 97NA  
Nitric Acid, Inhibited 97NA

[illegible]

|                             | NATURAL RUBBER | BRASS-15 (SAB) | BRVCL  | HYCAM (HUBA-15) | NEOPRENE | HYALON | SLI ECONO | VTBON | EPDM | RECLON |
|-----------------------------|----------------|----------------|--------|-----------------|----------|--------|-----------|-------|------|--------|
| Nitro Benzene               | D/U            | S              | H/U    | U               | F/D      | S      | U         |       |      |        |
| Nitro Ethane                | S              | F              | S      | U               | F        | S      | F/D       | S     |      |        |
| Nitro Methane               | S              | S              | S      | U               | F        |        |           |       |      |        |
| 1-Nitropropane              | F/DF/D         | S              | U      | F/D             |          | D      | F/S       |       |      |        |
| Nitrogen                    | S              | S              | S      | S               | S        | S      | S         | S     |      |        |
| Nitrogen Tetraoxide         |                |                | F      | S               | D        | D      | D         | S     |      |        |
| Octyl Alcohol               |                |                |        |                 | S        | S      | F         | S     |      |        |
| Oleic Acid                  | F/DF/D         | U              | F/DF/S | D               | U        |        |           | F     | S    |        |
| Olive Spicrite              | D/UD/UD/U      | S              |        | S               | U        | S      |           |       |      |        |
| o-Dichloro Benzene          |                | U              | U      | U               | U        | S      | S         |       |      |        |
| Oleic Acid                  |                |                |        |                 |          | F/S    |           |       |      | D/F    |
| Oxygen Cold                 | F              | P              | P      | F/S             |          | S      |           |       |      |        |
| Ozone                       |                |                |        |                 |          |        |           |       |      |        |
| Palmitic Acid               | U              | F              |        |                 |          |        |           |       |      | F      |
| Perchloric Acid             |                |                |        |                 |          |        |           |       |      |        |
| Perchloric Acid             |                |                |        |                 |          |        |           |       |      |        |
| Perchloric Acid             |                |                |        |                 |          |        |           |       |      |        |
| Perchloric Acid             |                |                |        |                 |          |        |           |       |      |        |
| Phenyl Benzene              | U              | U              | U      | U               | U        | S      |           |       |      |        |
| Phenyl Ethyl Ether          | U              | U              | U      | U               | U        | S      |           |       |      |        |
| Phenyl Hydrazine            | U              | P              | P/S    | U               | S        |        |           |       |      |        |
| Phenol                      | D              | U              | S      | H               | F/DF/D   | S      |           | F     | U    |        |
| Phosphate Esters            | U              | U              | S      |                 | U        | S      | S         |       |      |        |
| Phosphoric Acid             | F/S            | F              | F      | F/S             | S        | F/D    | S         |       |      |        |
| Phosphoric Acid 40%         |                |                |        | F               | F/S      | S      | S         |       |      |        |
| Phosphoric Acid 60%         |                |                |        | S               | D        | F/S    | S         | S     |      |        |
| Picric Acid                 | F              | F              | F      | F/S             | F        | S      | U         | S     | F    | U      |
| Plating Solutions, Chrome   | U              | S              |        |                 | U        | F/D    | S         |       |      |        |
| Plating Solutions, Others   | S              | S              | S      | S               | S        | F/D    | S         |       |      |        |
| Potassium Acetate           |                |                |        |                 | S        | S      | S         | S     |      |        |
| Potassium Chloride          | S              | S              | S      | S               | S        | S      | S         |       |      |        |
| Potassium Cyanide           | S              | S              | S      | S               | S        | S      | S         |       |      |        |
| Potassium Dichromate        |                |                |        |                 |          |        |           |       |      |        |
| Potassium Hydroxide         | S              | S              | S      | F/S             | S        | S      | S         |       |      |        |
| Potassium Nitrate           | S              | S              | S      | S               | S        | S      | S         |       |      |        |
| Potassium Sulfate           | U              | U              | U      | U               | U        | S      | S         |       |      |        |
| Producer Gas                | U              | U              | U      | U               | U        | S      | S         |       |      |        |
| Propene                     | U              | U              |        |                 |          | F/D    | S         |       |      |        |
| Propyl Acetate              |                |                |        |                 |          |        |           |       |      |        |
| Propyl Alcohol              | S              | S              | F/S    | S               | S        | F/D    | S         |       |      |        |
| Propyl Nitrate              |                |                | F/S    |                 |          | D      | S         |       |      |        |
| Propylene                   |                |                | U      | F/D             | U        | S      | S         |       |      |        |
| Pyridine                    | U              | U              | S      | U               | U        | U      | S         | F     | U    |        |
| Pyrolic                     | F              | F              | U      | U               | U        |        | S         | D     |      |        |
| Sal Ammoniac                | S              | S              | S      | S               | S        | F      | S         | U     |      |        |
| Saicylic Acid               | S              | S              | S      | S               | S        | S      | S         |       |      |        |
| Salt Water                  | S              | S              | S      | S               | S        | S      | S         |       |      |        |
| Sewage                      | S              | S              | S      | S               | S        | S      | S         |       |      |        |
| Silicate Esters             |                |                | S      | S               |          | F      | S         | S     |      |        |
| Silicone Greases            | S              | S              | S      | S               | S        | F/S    | S         | S     |      |        |
| Silicone Oils               | S              | S              | S      | S               | S        | F/S    | S         | S     |      |        |
| Silver Nitrate              | S              | S              |        |                 | S        | S      | S         |       |      |        |
| Soap Solutions              | S              | S              | S      | S               | S        | S      | S         |       |      |        |
| Soap Ash (Sodium Carbonate) | S              | S              | S      | S               | S        | S      | S         |       |      |        |
| Sodium Bicarbonate          | S              | S              | S      | S               | S        | S      | S         |       |      |        |
| Sodium Disulfate            | S              | S              | S      | S               | S        | S      | S         |       |      |        |
| Sodium Disulfite            | S              | S              | S      | S               | S        | S      | S         |       |      |        |
| Sodium Borate               | S              | S              | S      | S               | S        | S      | S         |       |      |        |
| Sodium Chloride             | S              | S              | S      | S               | S        | S      | S         |       |      |        |
| Sodium Cyanide              | S              | S              | S      | S               | S        | S      | S         |       |      |        |
| Sodium Hydroxide            | S              | S              | F/S    |                 | F/D      | S      | S         |       |      |        |
| Sodium Hypochlorite         | S              | S              | S      | S               | S        | S      | S         |       |      |        |
| Sodium Metaphosphate        | S              | S              | S      | S               | S        | S      | S         |       |      |        |
| Sodium Nitrate              | S              | S              | S      | S               | S        | S      | D         | S     |      |        |
| Sodium Peroxide             | S              | S              | S      | S               | S        | S      | D         | S     | U    |        |

# TYPICAL APPLICATIONS



## PNEUMATICALLY OPERATED STANDBY PUMPING SYSTEM:

With pump #1 on standby and valve #1 closed, pump #2 is supplying the cyclone header with ore slurry thru a full round opening series "SG" valve, #2. Pump #2 requires maintenance so pump #1 is started with valve #1 still closed. As pump #1 builds up pressure between its outlet and valve #1 the trapped air in the 18" line is relieved thru the small bypass "A" back to the sump. As soon as all air is relieved valve #1 opens and valve #2 closes. By relieving the trapped air thru the bypass the possibility of water hammer, which could damage valve #1 upon opening, is eliminated.



## LIQUID LEVEL CONTROL SYSTEM:

The Air-to-Open with Positioner, series "RAF", pinch valve is used to precisely control the level in the tank regardless of the variations in pump output pressure. A vacuum breaker or stand-pipe, higher than the maximum head of the pump, will eliminate any breathing or fluttering of the pinch valve body due to the hydraulic piston effect creating a vacuum on the downstream side of the valve. This hydraulic piston effect is more prevalent at certain controlled flow capacities than at other capacities and depends on the length, angle, and size of the vertical drop of the valve discharge pipe.



## AIR LOCK:

Two RKL air operated type "RAF" valves placed in series are used very satisfactorily as an air lock to unload from a pressure or vacuum tank or when placed above a tank, to load the vessel. There are numerous industrial and chemical applications, one of the most common of which is to replace the rotary valve under a cyclone separator in paper mills.

The system consists of one Air-to-Close valve (#2) and one Air-to-Open, fail Closed, valve (#1) to shut down the line in case of electric or air failure.

Valve #2 closes, then Valve #1 opens to admit material, either wet or dry, flowing by gravity into the volume created by spool piece "A". After an interval of time valve #1 closes and valve #2 opens allowing the material to flow onto a conveyor or into an appropriate receiver.

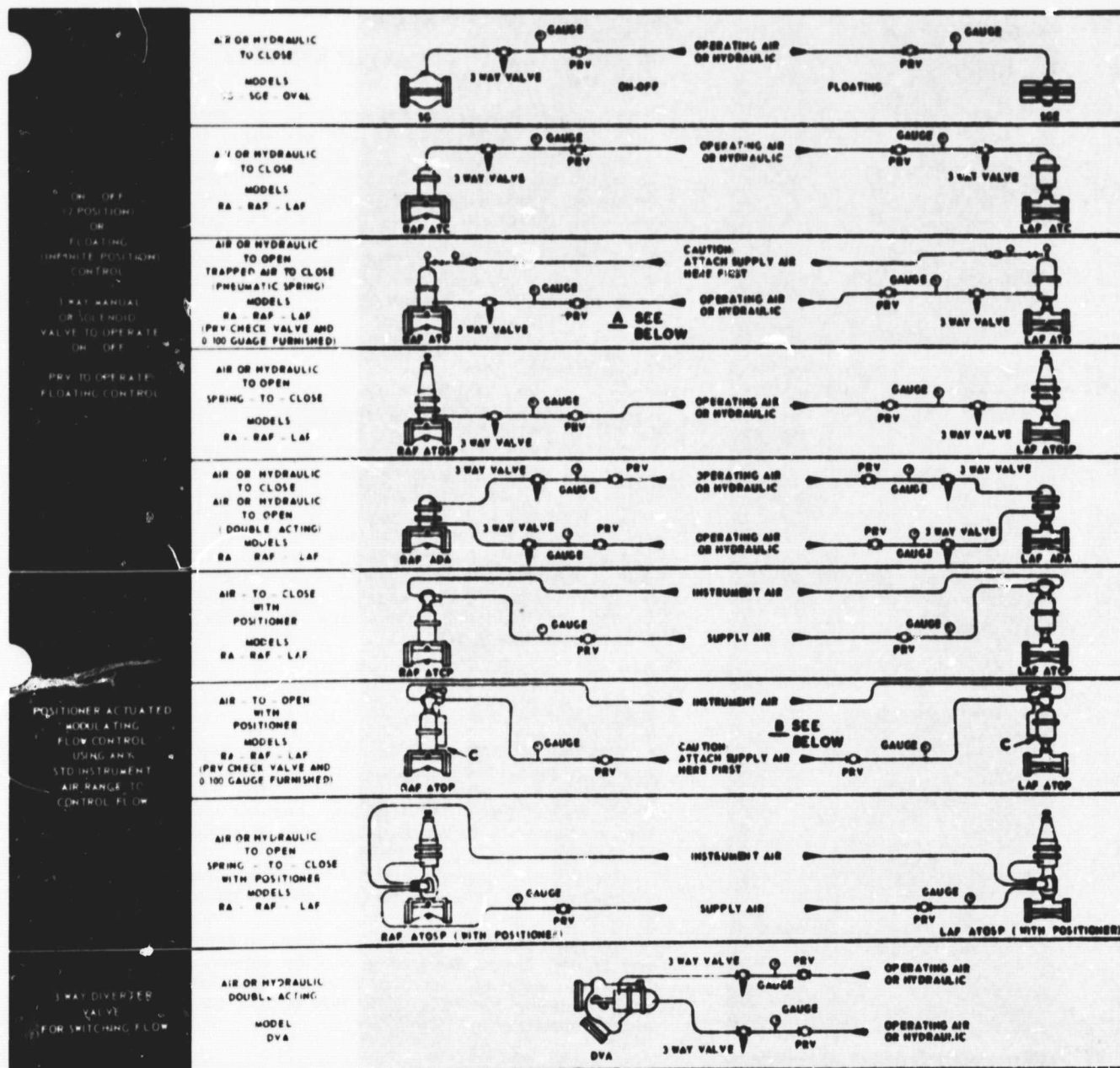


## DRIBBLE CONTROL (accuracy $\pm 1/4\%$ of full scale)

The batch weigher calls for a new batch which actuates solenoid valve #1 opening the fully enclosed series "L" Air-to-Open Spring to Close (fail closed) RKL Pinch Valve. When 90% of the batch has been weighed in, solenoid valve #2 actuates and extends cylinders "A" and "B". Solenoid valve #1 is then closed and the spring-to-close pinch valve closes to dribble position, as determined by cylinders "A" and "B". At about 99% of batch weight, solenoid valve #2 is closed and cylinders "A" and "B" retract to allow the pinch valve to close tightly.



# HOOKUP DIAGRAMS FOR RKL PNEUMATIC OR HYDRAULICALLY OPERATED VALVES

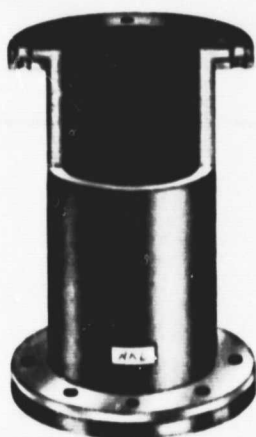


The length of life of a pinch valve varies with the application and is affected primarily by the working pressure, the working temperature, and the duty cycle. Presuming that all of these conditions are satisfactory, that the valve has been properly sized, and that the installation is correct, then we can say that on abrasive service, the life expectancy can be as much as five times as long as other types of valves. On corrosive fluid systems where the correct elastomer has been specified, life expectancy can be equal or greater than other types of valves.

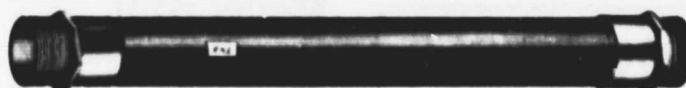
## TESTING

Each RKL Pinch Valve, regardless of type, is hydrostatically or pneumatically pressure tested for tight closure and then set to hold a pressure approximately ten percent higher than the maximum working pressure specified on the order, so that the rubber or elastomeric body cannot be overpinched by an operator. Certification of test will be furnished when requested at no additional charge.

## OTHER RKL PRODUCTS



**"VIBROSORB" VIBRATION ELIMINATOR**  
TEFLON\* (TFE) LINED OPTIONAL



**ELASTOMERIC VIBRATION ISOLATORS**

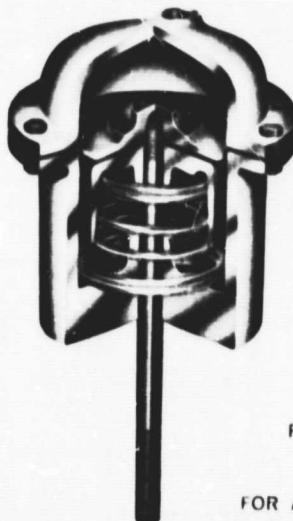


**"SPANSORB" EXPANSION JOINT**  
TEFLON\* (TFE) LINED OPTIONAL

## RKL ROLLOMOTOR ROLLING DIAPHRAGM LINEAR ACTUATORS



**AIR-TO-EXTEND WITH POSITIONER**



**ELECTRICALLY OPERATED  
WITH SLIDE WIRE**

PNEUMATIC — HYDRAULIC — ELECTRIC

### ROLLOMOTORS

FOR ALL TYPES OF LONG STROKE LINEAR ACTUATION

## HOW TO ORDER

1. Exact model number.
2. Quantity, size, & connection, (flange or slip-on)
3. Body material. Is positive opening feature required?
4. Service conditions.
  - A. Maximum & minimum line pressures through valve.
  - B. Maximum & minimum temperature.
  - C. For vacuum services state in inches of Mercury.
  - D. Acid or Alkali, advise concentration.
  - E. Abrasive, grit size, % solids, wet, dry.
5. Air or Hydraulically operated valves.
  - A. Air or hydraulic pressure to operate (psig).
  - B. Instrument air range (psig).
  - C. Reverse or direct acting positioner.
6. Electrically operated models.
  - A. State operating voltage.
  - B. On-off or modulating service.



# RKL CONTROLS, INC.

ARK ROAD, LUMBERTON, NEW JERSEY 08048 • PHONE (609) 267-2800 • TELEX 831-692

\* DUPONT TRADEMARK

COPYRIGHT 1977 RKL CONTROLS, INC.

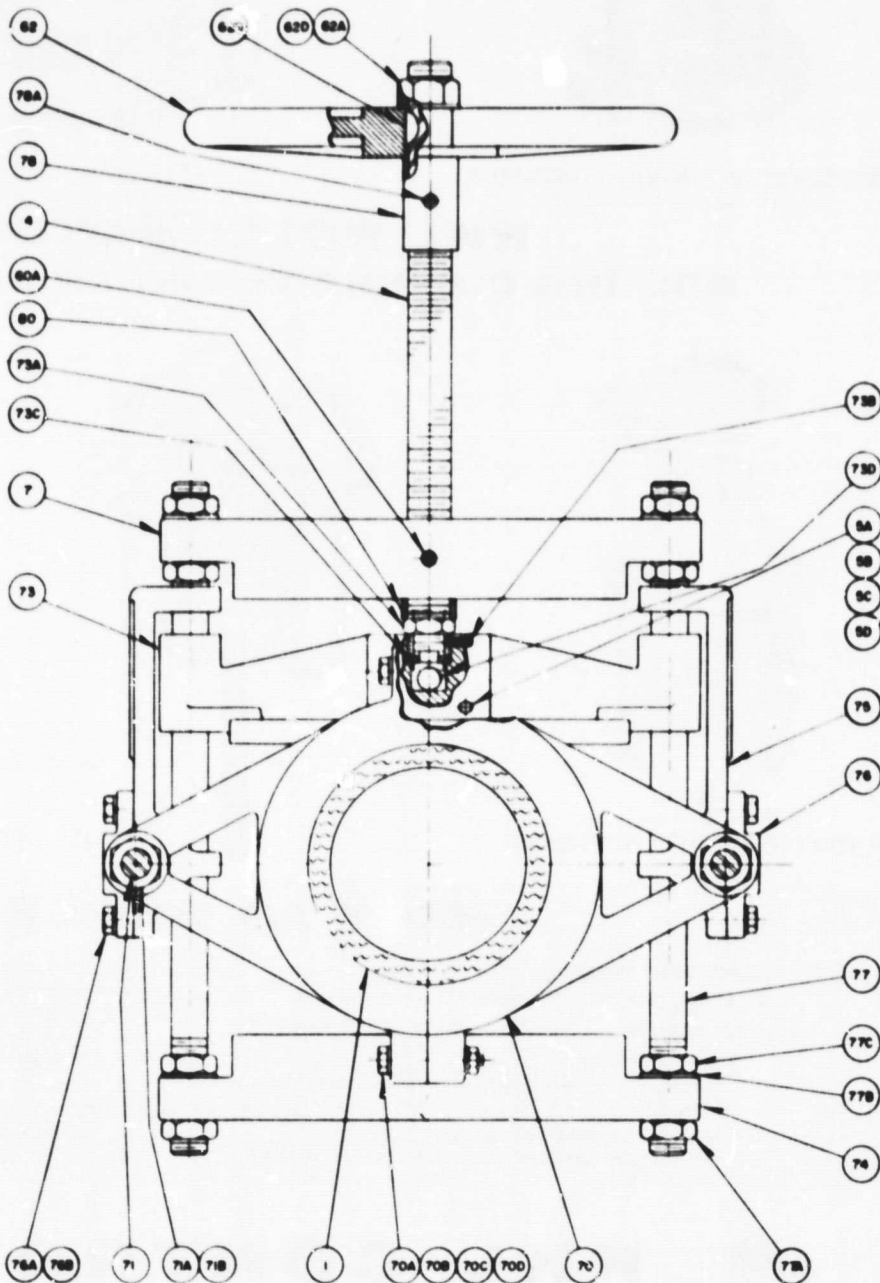
PRINTED IN U.S.A.

## RKL CONTROLS

**Model KSR**  
**Open Construction, Full Round,**  
**Manually Operated**

**D80033**

| ITEM | DESCRIPTION                       | QTY |
|------|-----------------------------------|-----|
| 1    | BODY                              | 1   |
| 4    | STEM                              | 1   |
| 8A   | BOLT, POF                         | 4   |
| 8B   | LOCK WASHER, POF                  | 4   |
| 8C   | WASHER, POF                       | 4   |
| 8D   | NUT, POF                          | 4   |
| 7    | Yoke                              | 1   |
| 60A  | CRANK PITTING                     | 1   |
| 60   | HAIR WHEEL                        | 1   |
| 62A  | RETAINING NUT, H/W                | 1   |
| 62B  | KEY, H/W                          | 1   |
| 62D  | LOCK WASHER, RETAINING NUT-H/W    | 1   |
| 70   | FLANGE ASSY                       | 2   |
| 70A  | BOLT, FLANGE ASSY                 | 8   |
| 70B  | LOCK WASHER, FLANGE ASSY          | 8   |
| 70C  | WASHER, FLANGE ASSY               | 8   |
| 70D  | NUT, FLANGE ASSY                  | 8   |
| 71   | TE-ROD, FLANGE ASSY               | 2   |
| 71A  | NUT, TE-ROD                       | 8   |
| 71B  | LOCK WASHER, TE-ROD               | 4   |
| 73   | UPPER FINCH BAR                   | 1   |
| 73A  | STEM RETAINER                     | 1   |
| 73B  | SET SCREW, STEM RETAINER          | 1   |
| 73C  | "C" WASHER, STEM-UPPER FINCH BAR  | 1   |
| 73D  | THRUST BALL, STEM-UPPER FINCH BAR | 1   |
| 74   | LOWER FINCH BAR                   | 1   |
| 75   | SIDE FRAME                        | 2   |
| 76   | SIDE PLATE                        | 2   |
| 76A  | BOLT, SIDE PLATE                  | 3   |
| 76B  | LOCK WASHER, SIDE PLATE           | 8   |
| 77   | GUIDE ROD                         | 2   |
| 77A  | NUT, GUIDE ROD                    | 4   |
| 77B  | LOCK WASHER, GUIDE ROD            | 4   |
| 77C  | JAM NUT, GUIDE ROD                | 4   |
| 78   | H/W COLLAR                        | 1   |
| 78A  | SPRING PIN, H/W COLLAR            | 1   |
| 80   | STEM COLLAR                       | 1   |





## INSTALLATION & MAINTENANCE

THE SERIES K (HANDWHEEL OPERATED) RKL PINCH VALVE IS COMPLETELY ASSEMBLED AND AND READY TO INSTALL.

1. BE SURE THE LENGTH OF PIPE LEFT OUT TO RECEIVE THE VALVE IS FOUR (4) TIMES THE NOMINAL PIPE DIAMETER FOR VALVE SIZES  $\frac{1}{2}$ " THRU 4" AND THREE (3) TIMES THE NOMINAL PIPE DIAMETER FOR VALVES SIZES 6" AND LARGER.
2. THE VALVE MAY BE MOUNTED IN ANY POSITON WITH THE FLOW IN EITHER DIRECTION. DO NOT INSTALL THE VALVE NEAR HOT STEAM LINES OR WHERE EXCESSIVE HEAT IS ENCOUNTERED.
3. MAKE SURE THE PIPE ENDS THAT ARE INSERTED INTO THE RUBBER BODY ARE FREE OF ANY BURRS, PIPE THREADS, OR PIPE WRENCH MARKS. THESE ENDS MUST BE SMOOTH FOR A TIGHT CONNECTION.
4. TO INSTALL THE VALVE, LOOSEN THE HOSE CLAMPS AND THE FOUR CLAMPING BOLTS (19 ON THE ATTACHED PRINT), AND INSERT YOUR PIPE IN BOTH ENDS UNTIL THE PIPE BUTTS UP AGAINST THE SHOULDERS INSIDE THE VALVE BODY. CLOSE THE VALVE, THEN RETIGHTEN THE FOUR CLAMPING BOLTS AND THE TWO HOSE CLAMPS.

## MAINTENANCE

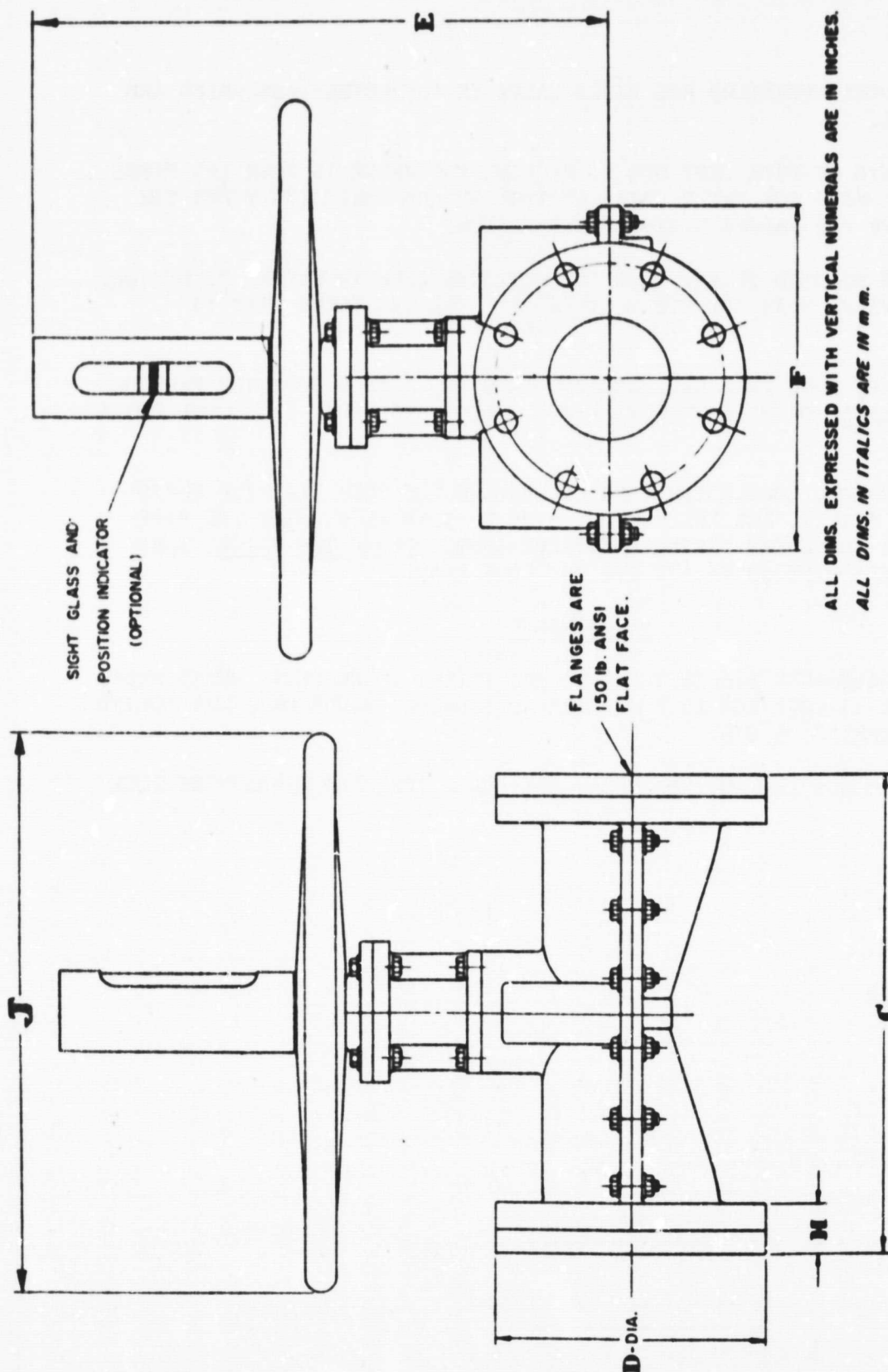
GREASE THE STEM OCCASIONALLY (#6 ON THE ATTACHED PRINT) TO PREVENT THREAD WEAR. NO OTHER MAINTENANCE IS REQUIRED AS THERE ARE NO PACKING GLANDS OR OTHER MOVING PARTS THAT REQUIRE GREASE OR OIL.

IF THE ABOVE INSTRUCTIONS ARE NOT FOLLOWED, ALL GUARANTEES AND WARRANTIES WILL BE VOID.

RKL CONTROLS  
ROBBINS & MYERS, INC.  
BOX 276, ARK RD.  
LUMBERTON, N.J. 08048  
ph: 609-267-2800  
telex: 831-692

REVISED: MAY 15, 1967

**Model LHW  
Enclosed, Pre-Pinched,  
Manually Operated**



ALL DIMS. EXPRESSED WITH VERTICAL NUMERALS ARE IN INCHES.  
ALL DIMS. IN ITALICS ARE IN mm.

| VALVE SIZE | 1         | 1 1/2     | 2         | 2 1/2     | 3          | 4           | 5          | 6           | 8          | 10         | 12        | 14      | 16         |
|------------|-----------|-----------|-----------|-----------|------------|-------------|------------|-------------|------------|------------|-----------|---------|------------|
| C          | 6 152     | 6 152     | 8 203     | 10 254    | 12 305     | 16 406      | 15 341     | 18 437      | 24 610     | 30 762     | 36 914    | 42 1067 | 48 1143    |
| D          | 4 1/4 108 | 5 127     | 6 152     | 7 178     | 7 1/2 191  | 9 229       | 10 254     | 11 279      | 13 1/2 343 | 16 406     | 19 483    | 21 533  | 23 1/2 597 |
| E          | 6 7/8 175 | 7 1/8 181 | 7 3/8 187 | 8 5/8 219 | 8 1/2 225  | 10 3/16 268 | 12 1/8 332 | 13 3/32 333 | 17 1/2 406 | 21 483     | 25 560    | 3 530   | 14 1/8 559 |
| F          | 5 1/4 123 | 6 1/8 156 | 7 178     | 8 7/8 225 | 10 1/4 260 | 12 1/8 308  | 13 1/4 337 | 15 1/8 403  | 18 3/4 476 | 22 1/2 577 | 27 686    | 28 737  | 33 1/4 857 |
| G          | 1 1/16 27 | 1/8 29    | 7/16 37   | 1 1/2 58  | 9/16 60    | 1 1/16 83   | 1 1/4 84   | 1 1/8 88    | 2 1/8 94   | 2 7/16 116 | 2 3/4 120 | 3 76    | 3 1/4 98   |
| J          | 6 152     | 6 152     | 7 178     | 7 3/4 197 | 7 3/4 197  | 10 254      | 12 305     | 14 356      | 16 406     | 20 508     | 24 600    | 28 711  | 32 803     |

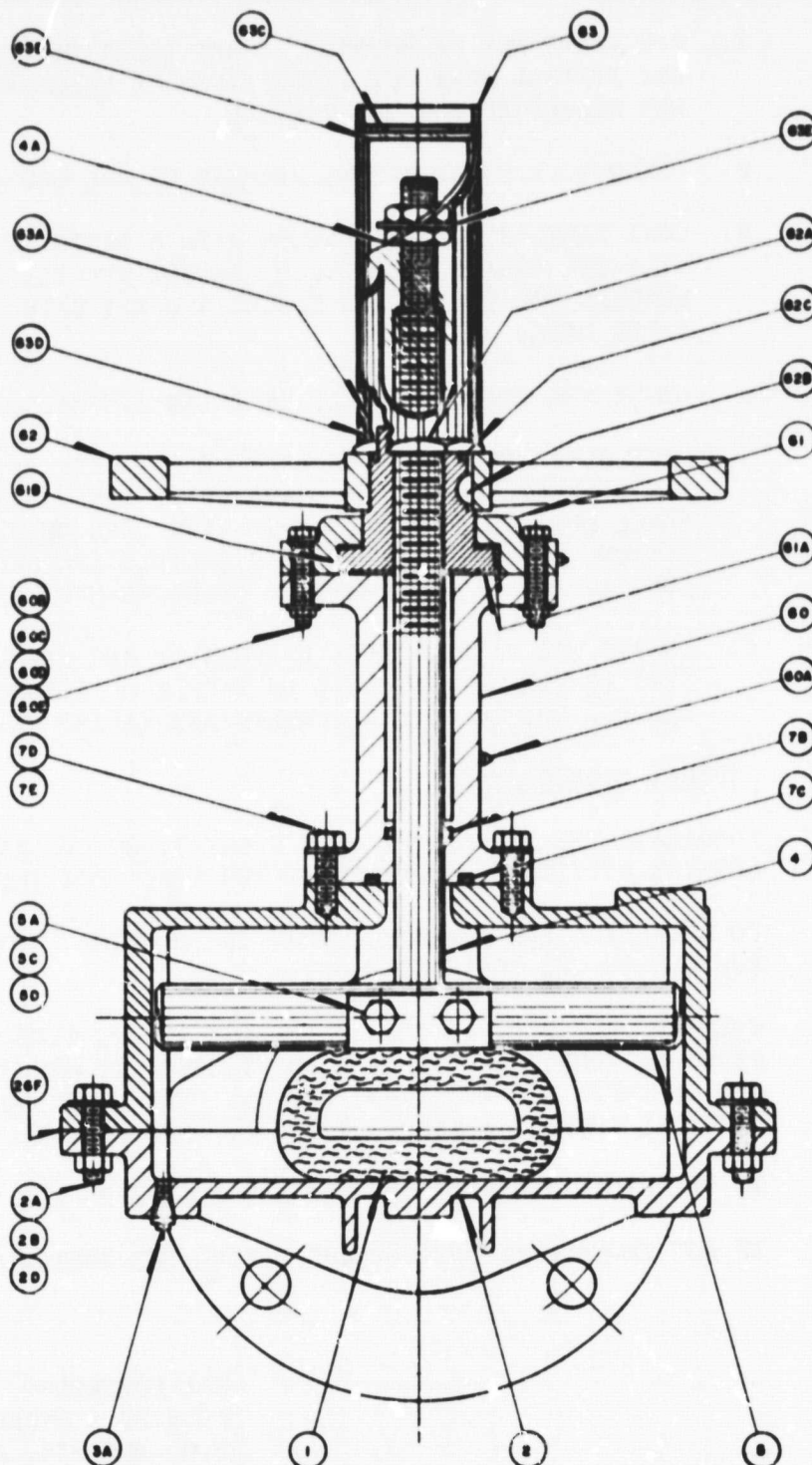
ORIGINAL PAGE IS  
OF POOR QUALITY

### ITEM DESCRIPTIONS REQ'D

|      |                            |     |
|------|----------------------------|-----|
| 1.   | BODY                       | 1   |
| 2.   | BONNET ASS'Y.              | 1   |
| 2A.  | BOLT, BONNETS              | *   |
| 2B.  | LOCK WASHER, BONNETS       | *   |
| 2D.  | NUT, BONNETS               | *   |
| 3A.  | PLUG, LOWER BONNET         | 1   |
| 4.   | STEM, VALVE                | 1   |
| 4A.  | MECHANICAL STOP, VALVE     | 2   |
| 5.   | PINCH BAR                  | 1   |
| 5A.  | BOLT, P.O.F.               | 2   |
| 5C.  | WASHER, P.O.F.             | 4   |
| 5D.  | NUT, P.O.F.                | 2   |
| 7B.  | "O"-RING, SPOOL-STEM       | 1   |
| 7C.  | "O"-RING, SPOOL-BONNET     | 1   |
| 60.  | SPOOL                      | 1   |
| 60A. | GREASE FITTING             | 2   |
| 60B. | BOLT, SPOOL-CAP            | 4   |
| 60C. | LOCK WASHER, SPOOL-CAP     | 4   |
| 60D. | WASHER, SPOOL-CAP          | 4   |
| 60E. | NUT, SPOOL-CAP             | 4   |
| 61.  | SPOOL CAP                  | 1   |
| 61A. | NYLATRON WASHER            | 2   |
| 61B. | BRASS NUT                  | 1   |
| 62.  | HANDWHEEL                  | 1   |
| 62A. | RETAINING NUT, H.W.        | 1   |
| 62B. | KEY, H.W.-BRASS NUT        | 1   |
| 63.  | SHEILD                     | * * |
| 63A. | LINER TUBE, SHEILD         | * * |
| 63B. | COVER, LINER TUBE          | * * |
| 63C. | RETAINING RING, LINER TUBE | * * |
| 63D. | "O"-RING, LINER TUBE       | * * |
| 63E. | POSITION RING              | * * |
| 62C. | LOCKING RING, HANDWHEEL    | 1   |
| 7D.  | BOLT, SPOOL-BONNET         | 4   |
| 7E.  | LOCK WASHER, SPOOL-BONNET  | 4   |
| 26F. | SEALANT                    | A/R |

\* SEE CHART BELOW

\* \* OPTIONAL



| ITEM | QUANTITY |       |    |       |    |    |    |    |       |    |    |    |    |    |    |    |
|------|----------|-------|----|-------|----|----|----|----|-------|----|----|----|----|----|----|----|
|      | PINCH    |       |    |       |    |    |    |    | VALVE |    |    |    |    |    |    |    |
|      | 1        | 1-1/2 | 2  | 2-1/2 | 3  | 4  | 5  | 6  | 8     | 10 | 12 | 14 | 16 | 18 | 20 | 24 |
| 2A   |          |       |    |       |    |    |    |    |       |    |    |    |    |    |    |    |
| 2B   | 6        | 8     | 10 | 10    | 10 | 12 | 14 | 14 | 14    | 18 | 18 | 18 | 28 | 32 | 32 | 32 |
| 2D   |          |       |    |       |    |    |    |    |       |    |    |    |    |    |    |    |



THE MODEL LHW (HANDWHEEL OPERATED) RKL PINCH VALVE IS COMPLETELY ASSEMBLED, PRESSURE TESTED CONFORMING TO YOUR PRESSURE AND TEMPERATURE SPECIFICATIONS AND IS READY FOR INSTALLATION.

1. THE VALVE MAY BE MOUNTED IN ANY POSITION WITH THE FLOW IN EITHER DIRECTION. DO NOT INSTALL NEAR HOT STEAM LINES OR WHERE EXCESSIVE HEAT IS ENCOUNTERED UNLESS valve WAS SPECIFIED FOR HOT SERVICE.
2. CLEAN YOUR METAL MATING FLANGES OF ALL OLD GASKETS AND ANY DIRT.
3. COAT VALVE'S RUBBER FLANGES WITH A PASTE SOLUTION OF GRAPHITE AND GLYCERINE OR SILICONE GREASE. IF THESE ARE NOT READILY AVAILABLE, USE SOAPY WATER. THIS ENABLES YOU TO INSTALL EASIER AND MAY SAVE YOU DIFFICULTY IN PARTING FLANGES AT A LATER DATE.
4. CLOSE THE VALVE WHILE IT IS BEING INSTALLED.
5. MAKE SURE THAT THE PIPE LINE ON ONE SIDE OF THE VALVE HAS ENOUGH PLAY IN IT SO THAT THE PIPE FLANGE CAN BE DRAWN UP TO THE VALVE, AS THE VALVE WILL NOT STRETCH AND THERE MUST BE ENOUGH PLAY TO TAKE CARE OF THE COMPRESSIBILITY OF THE ELASTOMERIC FLANGE. IF THE PIPE LINE IS SOLIDLY ANCHORED ON BOTH SIDES, THEN A FLEXIBLE JOINT, SUCH AS AN RKL VIBROSORB OR SPANSORB MUST BE USED IN THE PIPE LINE TO CREATE PLAY.
6. INSERT THE VALVE. PULL UP EQUALLY AND FIRMLY ON THE FLANGE BOLTS. AFTER IN SERVICE FOR 24 HRS, PULL UP FIRMLY ON FLANGE BOLTS AGAIN. THIS IS TO ELIMINATE ANY LEAKAGE DUE TO AN ELASTOMERIC SET TAKING PLACE.

#### GENERAL MAINTENANCE

LUBRICATE THE VALVE STEM ONLY EVERY 2,000 CYCLES; MORE OFTEN IF NOT CYCLED AS MUCH. AN ALEMITE FITTING IS SUPPLIED IN THE SPOOL FOR THIS PURPOSE.

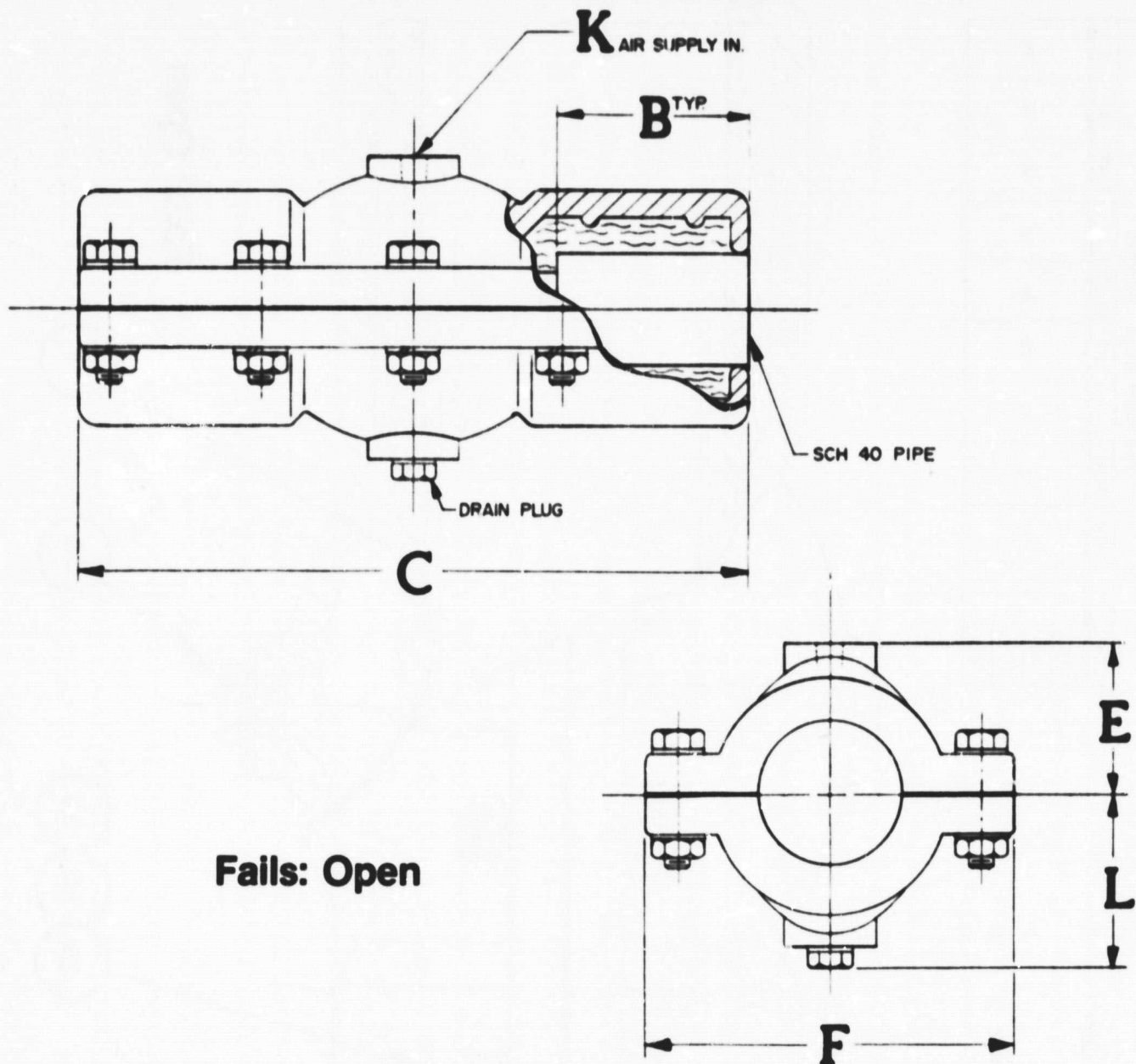
DO NOT USE A BAR (CHEATER) THRU THE HANDWHEEL TO TIGHTEN THE VALVE CLOSURE AS OVERTORQUE CAN DAMAGE THE BRASS STEM NUT.

THE TWO LOCK NUTS ON THE END OF THE RISING STEM HAVE BEEN ADJUSTED UNDER ACTUAL PRESSURE CONDITIONS TO GIVE YOU TIGHT SHUT OFF FOR YOUR PARTICULAR PRESSURE CONDITIONS AND IN THEIR SET POSITION, PREVENT OVER PINCHING OF THE RUBBER PINCH VALVE BODY. ONLY ADJUST  $\frac{1}{2}$  TURN AT A TIME, OR CONSULT THE FACTORY.

IF THE ABOVE INSTRUCTIONS ARE NOT FOLLOWED, ALL GUARANTIES AND WARRANTIES WILL BE VOID.

IF ANY TROUBLE IS ENCOUNTERED DURING THE INSTALLATION OF THIS VALVE CALL:

RKL CONTROLS  
ROBBINS & MYERS  
P.O. BOX 276, ARK RD.  
LUMBERTON, N.J. 08048  
PH: 609-267-2800, TELEX: 831-692



**Fails: Open**

NOTE: ALL DIMENSIONS ARE IN INCHES.

| VALVE SIZE | 1/4     | 1/2     | 3/4     | 1       | 1-1/4   | 1-1/2   | 2       | 2-1/2   | 3       | 4       |
|------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| B DIM.     | 1-7/16  | 1-11/16 | 1-13/16 | 2-3/32  | 2-1/2   | 3       | 3-1/8   | 3-5/8   | 4-1/8   | 5-1/8   |
| C DIM.     | 4-7/8   | 5-3/4   | 6-3/8   | 7-3/16  | 8-1/2   | 10-1/4  | 11-3/4  | 14-1/4  | 16-1/4  | 20-1/4  |
| E DIM.     | 1-1/16  | 1-1/4   | 1-7/16  | 1-11/16 | 2       | 2-3/16  | 2-5/8   | 3-3/16  | 3-5/8   | 4-5/8   |
| F DIM.     | 2-3/4   | 3-1/4   | 3-1/2   | 4-1/8   | 4-1/2   | 4-3/4   | 5-1/2   | 6-5/8   | 7-1/2   | 8-3/4   |
| K PORTS    | 1/8 NPT | 1/8 NPT | 1/8 NPT | 1/4 NPT | 1/4 NPT | 1/4 NPT | 1/4 NPT | 1/4 NPT | 1/4 NPT | 1/4 NPT |
| L DIM.     | 1-3/8   | 1-9/16  | 1-3/4   | 2       | 2-5/16  | 2-1/2   | 2-15/16 | 3-1/2   | 4       | 5       |
|            |         |         |         |         |         |         |         |         |         |         |
|            |         |         |         |         |         |         |         |         |         |         |



# RKL CONTROLS

Model SGE  
Enclosed, Pre-Pinched  
No Actuator required

C80031

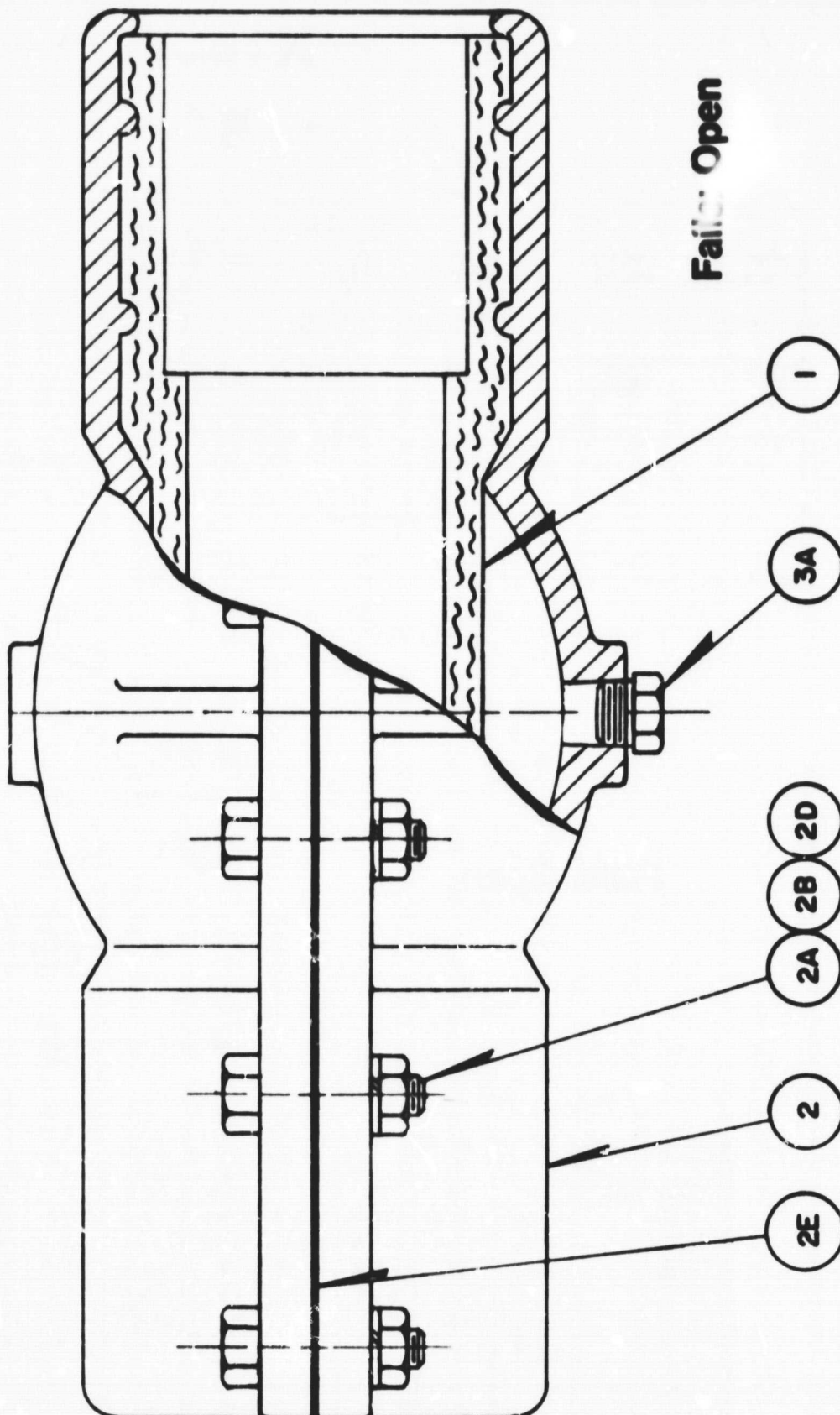
\* SEE CHART FOR QUANTITY

| ITEM | QUANTITY                |     |     |    |       |       |    |       |    |    |
|------|-------------------------|-----|-----|----|-------|-------|----|-------|----|----|
|      | SGE PINCH VALVE BONNETS |     |     |    |       |       |    |       |    |    |
|      | 1/4                     | 1/2 | 3/4 | 1  | 1-1/4 | 1-1/2 | 2  | 2-1/2 | 3  | 4  |
| 2A   |                         |     |     |    |       |       |    |       |    |    |
| 2B   | 8                       | 10  | 10  | 10 | 10    | 12    | 12 | 16    | 16 | 20 |
| 2D   |                         |     |     |    |       |       |    |       |    |    |

## DESCRIPTIONS

## ITEM

|    |                          |   |
|----|--------------------------|---|
| 1. | BODY                     | 1 |
| 2. | BONNET ASSEMBLY          | 1 |
| 2A | BOLT, BONNET ASSY        | * |
| 2B | LOCK WASHER, BONNET ASSY | * |
| 2D | NUT, BONNET ASSY         | * |
| 2E | GASKET, BONNET ASSY      | 2 |
| 3A | PLUG, BONNET ASSY        | 1 |



## INSTALLATION & MAINTENANCE

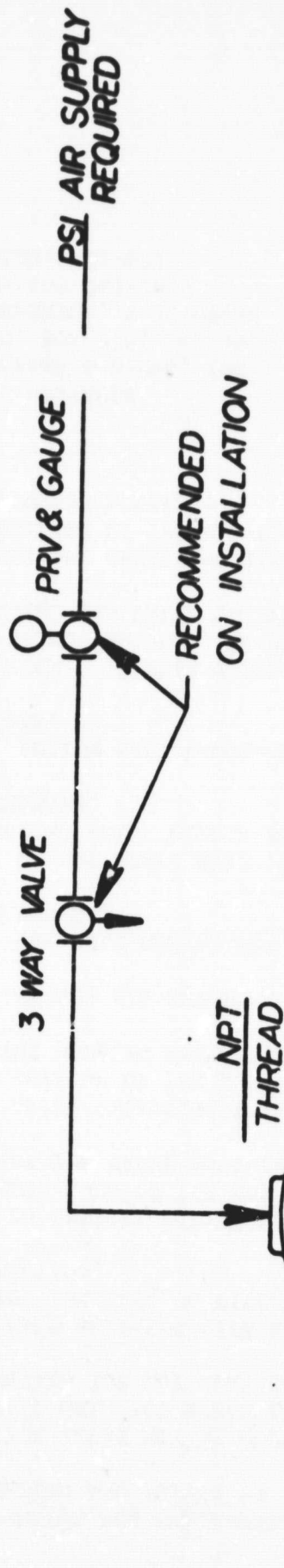
THE SERIES SGE (SLIP-ON CONNECTIONS, AIR OPERATED) PINCH VALVE HAS BEEN COMPLETELY ASSEMBLED AND TESTED TO CONFORM TO THE CONDITIONS OF YOUR APPLICATION.

1. THE VALVE MAY BE MOUNTED IN ANY POSITION WITH THE FLOW IN EITHER DIRECTION. DO NOT INSTALL NEAR HOT STEAM LINES OR WHERE EXCESSIVE HEAT IS ENCOUNTERED UNLESS VALVE WAS SPECIFIED FOR HOT SERVICE.
2. MAKE SURE THE PIPE ENDS THAT ARE INSERTED INTO THE RUBBER BODY ARE FREE FROM ANY BURRS, THREADS, OR PIPE WRENCH MARKS. THESE ENDS MUST BE SMOOTH AND CLEAN FOR A TIGHT CONNECTION.
3. TO INSTALL VALVE, LOOSEN THE BOLTS AND REMOVE THE VALVE HOUSING. INSERT YOUR PIPE IN BOTH ENDS OF THE RUBBER VALVE BODY UNTIL THE PIPE BUTTS UP AGAINST THE SHOULDERS INSIDE THE VALVE BODY (IF NECESSARY, MEASURE TO INSURE PROPER INSERTION).
4. AFTER INSERTING PIPE, BOLT THE HOUSING HALVES TOGETHER, THE YELLOW LINE MARKED ON THE OUTSIDE OF THE RUBBER VALVE BODY SHOULD BE ALIGNED WITH THE SEAM WHERE THE HALVES OF THE HOUSING MEET (EITHER SIDE IS ACCEPTABLE).
5. ATTACH AIR SUPPLY AT CONNECTION IN TOP OF VALVE HOUSING.
6. USE ONLY CLEAN, DRY, NON-LUBRICATED AIR OR SPECIFIED HYDRAULIC FLUID TO OPERATE THE VALVE.
7. DO NOT APPLY MORE PRESSURE THAN SPECIFIED TO OPERATE THE VALVE. USE A PRESSURE REDUCING VALVE WITH A BUILT-IN RELIEF PORT TO REDUCE YOUR PLANT AIR PRESSURE, IF NECESSARY.
8. FOLLOW SAME PROCEDURE AS OUTLINED ABOVE WHEN INSTALLING REPLACEMENT RUBBER VALVE BODIES.

CAUTION: IF THIS VALVE IS INSTALLED AFTER A PUMP, BE SURE IT IS FULLY OPEN BEFORE STARTING THE PUMP, OR RELIEVE THE AIR PRESSURE BETWEEN THE VALVE AND PUMP BEFORE OPENING THE VALVE TO PREVENT DAMAGE TO THE RUBBER LINER DUE TO HYDRAULIC HAMMER.

QUESTIONS REGARDING INSTALLATION OF NEW VALVES OR REPLACEMENT BODIES, OR PROPER OPERATION OF THE VALVE, SHOULD BE REFERRED TO THE CUSTOMER SERVICE DEPARTMENT AT THE FOLLOWING ADDRESS:

RKL CONTROLS  
ROBBINS & MYERS, INC.  
P.O. BOX 276, ARK RD.  
LUMBERTON, N.J. 08048  
PH: 609-267-2800  
TELEX: 831-692

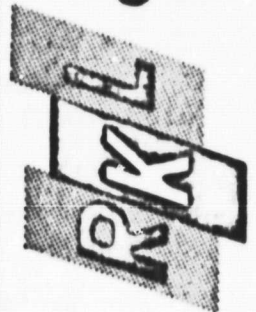


|                |  |
|----------------|--|
| VALVE SIZE     |  |
| END CONNECTION |  |
| BODY MATERIAL  |  |
| MAX TEMP.      |  |
| LINE PRESSURE  |  |

172

ORIGINAL PAGE IS  
OF POOR QUALITY

AIR HOOKUP DIAGRAM FOR SERIES 'SGE' VALVES



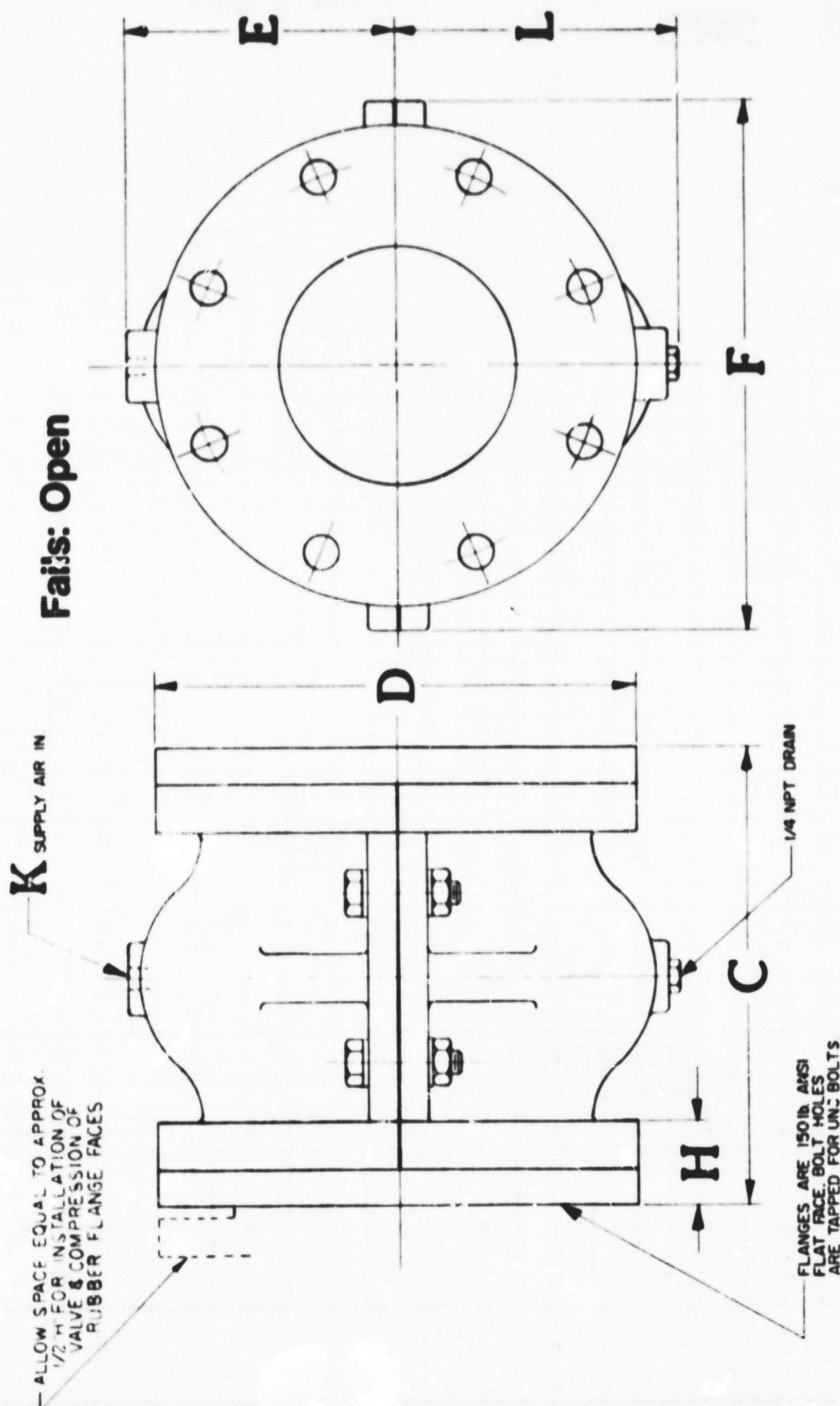
**CONTROLS, INC.**  
HAINESPORT INDUSTRIAL PARK  
HAINESPORT, N.J.



# RKL CONTROLS

**Model SG**  
**Enclosed, Full Round,**  
**No Actuator required**

**C40047**



ALL DIMENSIONS ARE IN INCHES

| VALVE SIZE | 1     | 1-1/4  | 1-1/2   | 2     | 2-1/2 | 3     | 4     | 5       | 6      | 8      | 10     | 12      | 14     | 16     | 18     | 20     | 24     | 30     |
|------------|-------|--------|---------|-------|-------|-------|-------|---------|--------|--------|--------|---------|--------|--------|--------|--------|--------|--------|
| C-DIM      | 4     | 4-5/16 | 4-3/4   | 5-1/4 | 5-3/4 | 6     | 8     | 10      | 12     | 16     | 20     | 24      | 28     | 32     | 36     | 40     | 48     | 60     |
| D-DIA      | 4-1/4 | 4-5/8  | 5       | 6     | 7     | 7-1/2 | 9     | 10      | 11     | 13-1/2 | 16     | 19      | 21     | 23-1/2 | 25     | 27-1/2 | 32     | 38-3/4 |
| E-DIM      | 2-3/4 | 2-5/8  | 3-1/4   | 3-1/4 | 3-3/4 | 4-1/4 | 5     | 5-7/8   | 7      | 8-3/4  | 10-1/2 | 11-3/4  | 13-5/8 | 15-1/4 | 16-3/8 | 18-3/4 | 24     | 31     |
| F-DIM      | 4-1/4 | 5-1/4  | 5-1/8   | 6-1/4 | 7     | 7-1/2 | 9-3/4 | 11      | 11-1/2 | 14-1/2 | 17     | 20      | 22-1/2 | 24-1/4 | 26-1/2 | 29-1/2 | 36     | 45     |
| H-DIM      | 1     | 1-1/8  | 1-1/8   | 1-1/4 | 1-1/4 | 1-1/2 | 1-3/4 | 2       | 2-1/8  | 2-3/8  | 2-5/8  | 2-3/4   | 3-3/8  | 3-1/2  | 3-5/8  | 4-1/4  | 4-3/4  | 5-1/4  |
| K-PORT     |       |        | 1/4 NPT |       |       |       |       | 1/2 NPT |        |        |        | 3/4 NPT |        |        | 1 NPT  |        |        |        |
| L-DIM      | 3     | 2-7/8  | 3-1/2   | 3-1/2 | 4     | 4-1/2 | 5-1/4 | 6-1/8   | 7-1/4  | 9      | 10-3/4 | 12      | 13-7/8 | 15-1/2 | 15-5/8 | 19     | 24-1/4 | 29-1/4 |

# RKL CONTROLS

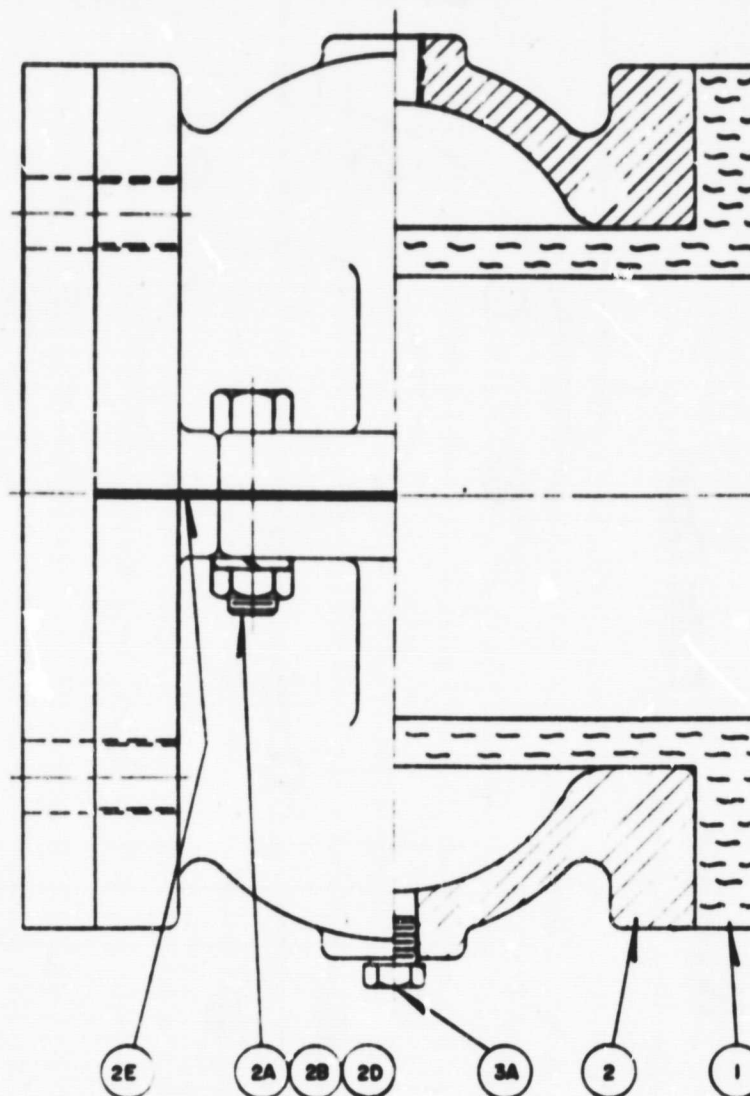
Enclosed, Pre-Pinched  
No Actuator required

## ITEM DESCRIPTIONS REQ'D

|    |                           |   |
|----|---------------------------|---|
| 1  | BODY                      | 1 |
| 2  | BONNET ASSEMBLY           | 1 |
| 2A | BOLT, BONNET ASS'Y        | * |
| 2B | LOCK WASHER, BONNET ASS'Y | * |
| 2D | NUT, BONNET ASS'Y         | * |
| 2E | GASKET, BONNET ASS'Y      | 2 |
| 3A | PLUG, BONNET ASS'Y        | 1 |

\* SEE "CHART" BELOW FOR QUANTITY.

Falls: Open

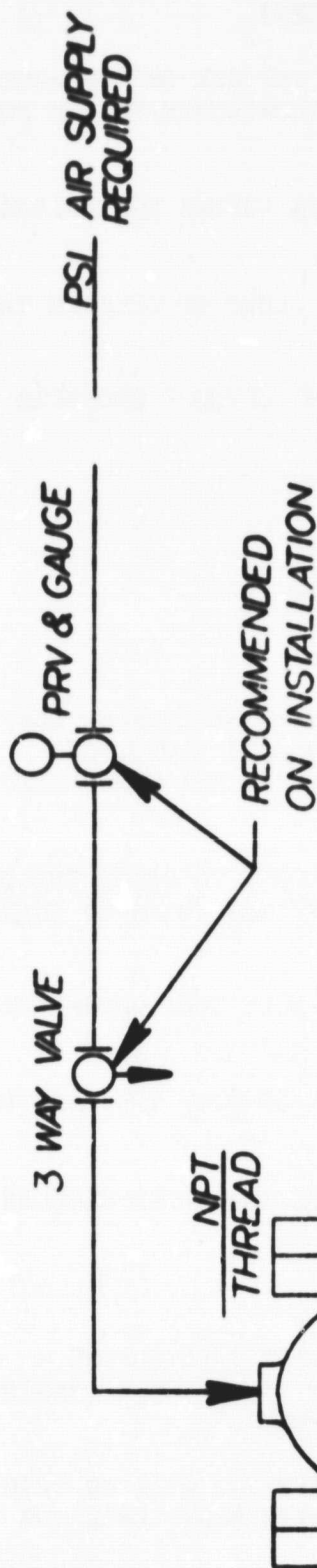


## QUANTITY

### SG PINCH VALVE BONNETS

| ITEM | 1 | 1-1/4 | 1-1/2 | 2 | 2-1/2 | 3 | 4 | 5 | 6 | 8  | 10 | 12 | 14 | 16 | 18 |
|------|---|-------|-------|---|-------|---|---|---|---|----|----|----|----|----|----|
| 2A   |   |       |       |   |       |   |   |   |   |    |    |    |    |    |    |
| 2B   | 4 | 4     | 4     | 4 | 4     | 4 | 4 | 4 | 8 | 10 | 10 | 12 | 16 | 16 | 18 |
| 2D   |   |       |       |   |       |   |   |   |   |    |    |    |    |    |    |





|               |  |
|---------------|--|
| VALVE SIZE    |  |
| BODY MATERIAL |  |
| MAX. TEMP     |  |
| LINE PRESSURE |  |

AIR HOOKUP DIAGRAM FOR SERIES 'SG' VALVES



**CONTROLS, INC.**  
 HAINESPORT INDUSTRIAL PARK  
 HAINESPORT, N.J.

**INSTALLATION AND MAINTENANCE INSTRUCTIONS  
(REPLACEMENT OF HOUSING GASKETS AND VALVE BODIES)**

1. THIS VALVE IS RECEIVED FROM THE FACTORY READY FOR INSTALLATION AND AIR OR HYDRAULIC HOOK-UP AS PER THE ATTACHED HOOK-UP DIAGRAM. THIS VALVE HAS BEEN THOROUGHLY TESTED FOR TIGHTNESS BEFORE SHIPMENT.
2. USE A LUBRICANT NOT HARMFUL TO RUBBER ON THE FACE OF THE FLANGES BEFORE INSTALLING THE VALVE.
3. USE ONLY CLEAN, DRY, NON-LUBRICATED AIR OR SPECIFIED HYDRAULIC FLUID TO OPERATE THE VALVE.
4. DO NOT APPLY MORE PRESSURE THAN SPECIFIED ON THE HOOKUP DIAGRAM, USING A PRESSURE REDUCING VALVE AS SHOWN, IF NECESSARY.

**REPLACEMENT OF GASKETS AND BODY**

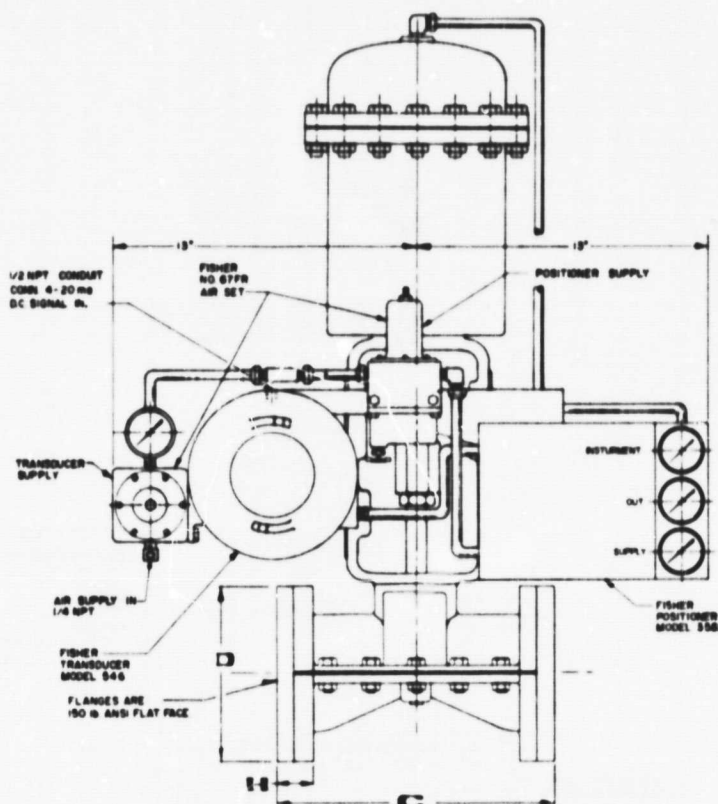
1. IF GASKETS NEED REPLACING, REMOVE THE VALVE FROM THE LINE AND SEPARATE THE VALVE HOUSING BY REMOVING BOLTS AND NUTS NO. 3 AND 5 AS SHOWN ON DRAWING IGS-722C.
2. CLEAN GASKETED SURFACES COMPLETELY AND APPLY NEW GASKETS.
3. WHEN INSTALLING NEW RUBBER BODY, COAT THE BACK OF THE NEW BODY FLANGES FOR AT LEAST 2" ALONG THE SPOOL OF THE BODY FROM EITHER END WITH A GLYCERINE AND WATER SOLUTION, VASOLENE, OR OTHER LUBRICANT, WHICH WILL NOT ATTACK RUBBER. (SILICONE GREASE MAY ALSO BE USED.)
4. INSERT NEW BODY IN ONE VALVE HOUSING HALF, ALLOWING AN EQUAL AMOUNT TO STICK OUT OF EITHER END. BE SURE TO ALIGN THE BOLT HOLES IN THE RUBBER BODY WITH THE THREADED HOLES IN THE HOUSING.
5. PLACE OTHER HALF OF THE VALVE HOUSING OVER THE RUBBER BODY AND BOLT THE TWO HALVES TOGETHER WITH NEW GASKETS, #6 ON PRINT IGS-722C.
6. TIGHTEN THE HOUSING BOLTS TIGHTLY AND TRIM THE EXCESS GASKET FLUSH WITH THE CASTING ON BOTH SIDES AND ENDS OF THE VALVE.
7. COAT THE FACE OF THE RUBBER FLANGES WITH A LUBRICANT NON-HARMFUL TO RUBBER SUCH AS A SOLUTION OF GLYCERINE AND WATER OR VASOLENE.
8. FOLLOW THE INSTRUCTIONS ABOVE FOR INSTALLATION OF THE VALVE.

**CAUTION:** IF THIS VALVE IS INSTALLED AFTER A PUMP, BE SURE IT IS FULLY OPEN BEFORE STARTING THE PUMP OR RELIEVE THE AIR PRESSURE BETWEEN THE VALVE AND PUMP BEFORE OPENING THE VALVE TO PREVENT DAMAGE TO THE RUBBER LINER DUE TO HYDRAULIC HAMMER.

IF THE ABOVE INSTRUCTIONS ARE NOT FOLLOWED, ALL GUARANTEES AND WARRANTIES WILL BE VOID. IF YOU HAVE ANY QUESTIONS WHEN INSTALLING A VALVE OR REPLACING A VALVE BODY, CALL OUR PLANT DIRECTLY.

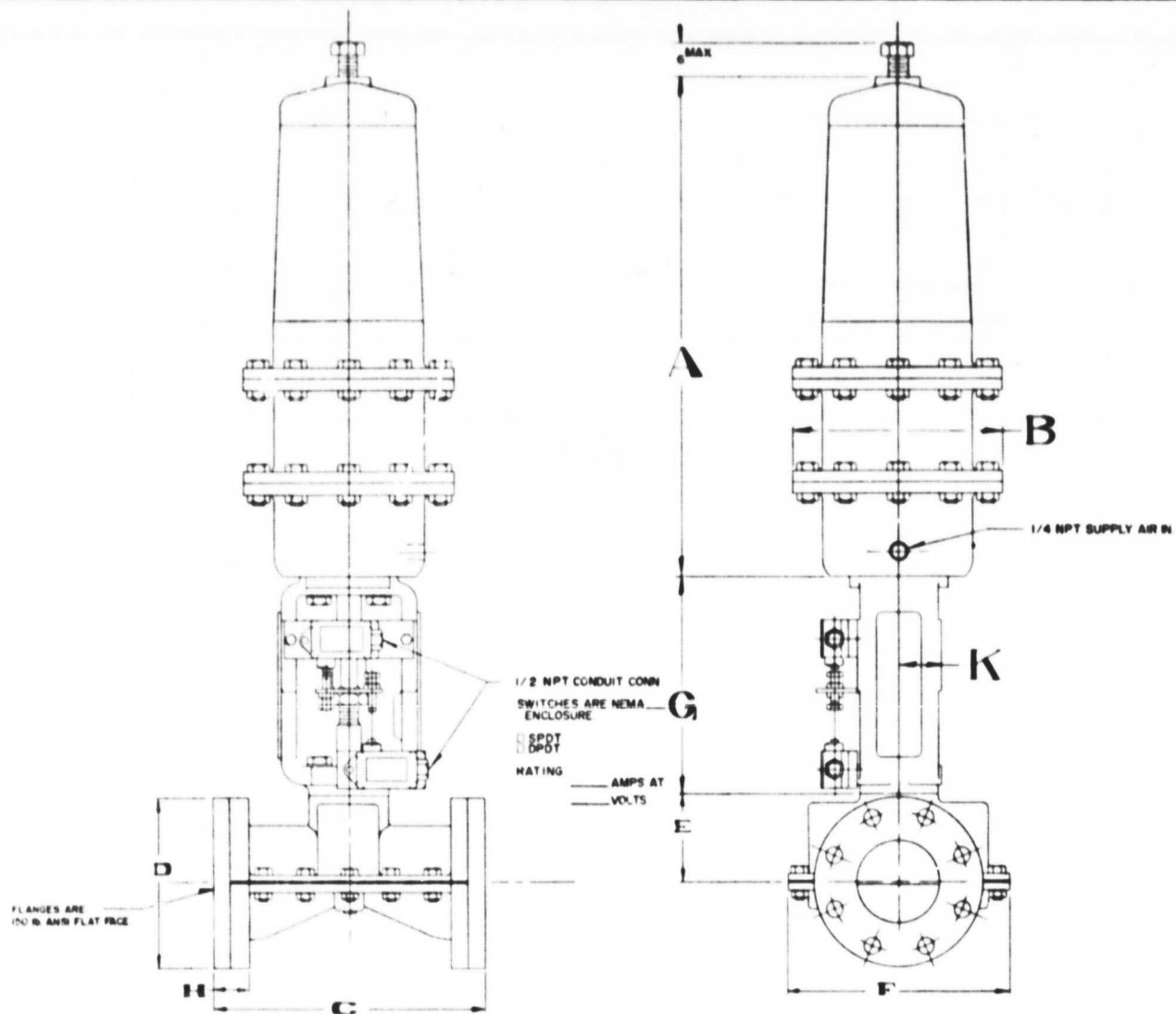
RKL CONTROLS  
ROBBINS AND MYERS, INC.  
P.O. BOX 276, ARK RD.  
LUMBERTON, N.J. 08048  
PH: 609-267-2800 TELEX: 831-692

C-3



## Fails: Open

[illegible]



| ACTUATOR SIZE | 14    | 26     | 35     | 60     | 100    | 150    | 186    |
|---------------|-------|--------|--------|--------|--------|--------|--------|
| A DIMENSION   | 19    | 22-3/4 | 17-3/8 | 30-7/8 | 39-3/4 | 60-1/4 | 61-1/2 |
| B DIAMETER    | 6-3/4 | 8-3/8  | 12     | 11-3/4 | 14-3/4 | 18-1/2 | 19     |

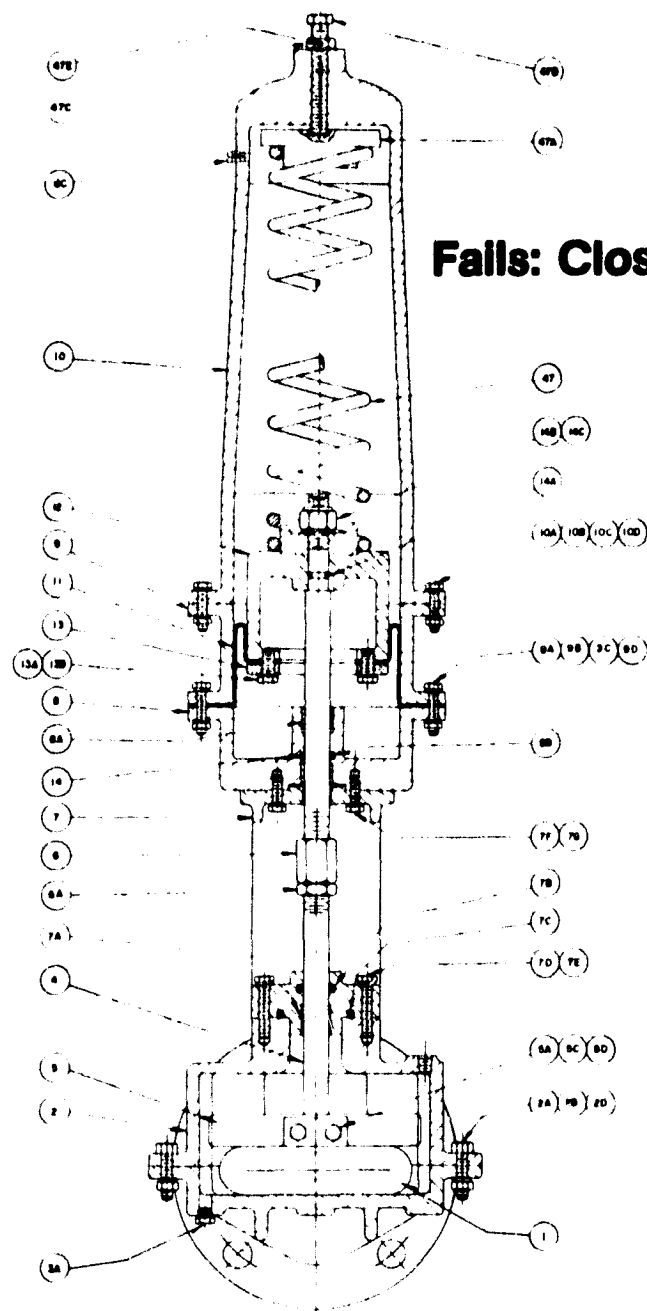
**Fails: Closed**

NOTE: ALL DIMENSIONS ARE IN INCHES.

| VALVE SIZE        | 1      | 1-1/2 | 2      | 2-1/2    | 3        | 4        | 5        | 6        | 8       | 10     | 12     | 14    | 16     | 18     |  |  |
|-------------------|--------|-------|--------|----------|----------|----------|----------|----------|---------|--------|--------|-------|--------|--------|--|--|
| C DIMENSION       | 6      | 6     | 8      | 10       | 12       | 16       | 15       | 18       | 24      | 30     | 36     | 42    | 45     | 50-1/4 |  |  |
| D DIAMETER        | 4-1/4  | 5     | 6      | 7        | 7-1/2    | 9        | 10       | 11       | 13-1/2  | 16     | 19     | 21    | 23-1/2 | 25     |  |  |
| E DIMENSION       | 2-7/16 | 2-5/8 | 3      | 3-9/16   | 3-13/16  | 4-15/16  | 5-1/2    | 6        | 7-13/16 | 9-1/2  | 11-5/8 | 13    | 14-1/8 | 16-3/4 |  |  |
| F DIMENSION       | 5-1/4  | 6-1/8 | 7      | 8-7/8    | 10-1/4   | 12-1/8   | 13-1/4   | 15-7/8   | 18-3/4  | 22     | 26     | 29    | 33-3/4 | 39-1/2 |  |  |
| G DIMENSION       | 8-7/8  | 8-7/8 | 8-7/8  | 10-11/16 | 10-11/16 | 13-13/16 | 13-13/16 | 13-13/16 | 19-1/2  | 19-1/2 | 20     | 20    | 20     | 20     |  |  |
| H DIMENSION (THK) | 1-1/16 | 1-1/8 | 1-7/16 | 1-1/2    | 1-9/16   | 1-11/16  | 1-3/4    | 1-7/8    | 2-1/8   | 2-7/16 | 2-3/4  | 3     | 3-3/4  | 3-3/4  |  |  |
| K DIMENSION       | 2-1/4  | 2-1/4 | 2-1/4  | 2-3/8    | 2-3/8    | 2-5/8    | 2-5/8    | 2-5/8    | 3-1/4   | 3-1/4  | 5-1/4  | 5-1/4 | 5-1/4  | 5-1/4  |  |  |
| L DIMENSION       |        |       |        |          |          |          |          |          |         |        |        |       |        |        |  |  |
| M DIAMETER        |        |       |        |          |          |          |          |          |         |        |        |       |        |        |  |  |



| ITEM | DESCRIPTIONS                        | REQ'D |
|------|-------------------------------------|-------|
| 1    | BODY                                | 1     |
| 2    | BONNET ASS'Y                        | 1     |
| 2A   | BOLT, BONNETS                       | *     |
| 2B   | LOCK WASHER, BONNETS                | *     |
| 2D   | NUT, BONNETS                        | *     |
| 8C   | BREATHER PLUG, ACTUATOR             | 1     |
| 3A   | PLUG, LOWER BONNET                  | 1     |
| 1    | STEM, VALVE                         | 1     |
| 5    | PINCH BAR                           | 1     |
| 5A   | BOLT P.O.F.                         | 2     |
| 5C   | WASHER, P.O.F.                      | 4     |
| 5D   | NUT, P.O.F.                         | 2     |
| 6    | COUPLING                            | 1     |
| 6A   | JAM NUT, COUPLING                   | 1     |
| 7    | YOKE                                | 1     |
| 7A   | BEARING, YOKE                       | 1     |
| 7B   | "O"-RING, YOKE-STEM                 | 1     |
| 7C   | "O"-RING, YOKE-BONNET               | 1     |
| 7D   | BOLT, YOKE-BONNET                   | 4     |
| 7E   | LOCK WASHER, YOKE-BONNET            | 4     |
| 7F   | BOLT, YOKE-ACTUATOR                 | 4     |
| 7G   | LOCK WASHER, YOKE-ACTUATOR          | 4     |
| 8    | CYLINDER BOTTOM, ACTUATOR           | 1     |
| 8A   | BEARING, CYLINDER BOTTOM            | 2     |
| 8B   | "O"-RING, CYLINDER BOTTOM           | 1     |
| 9    | CYLINDER MIDDLE, ACTUATOR           | 1     |
| 9A   | BOLT, MIDDLE-BOTTOM CYLINDER        | * *   |
| 9B   | LOCK WASHER, MIDDLE-BOTTOM CYLINDER | * *   |
| 9C   | WASHER, MIDDLE-BOTTOM CYLINDER      | * *   |
| 9D   | NUT, MIDDLE-BOTTOM CYLINDER         | * *   |
| 10   | CYLINDER HEAD ACTUATOR              | 1     |
| 10A  | BOLT, HEAD-MIDDLE CYLINDER          | * *   |
| 10B  | LOCK WASHER, HEAD-MIDDLE CYLINDER   | * *   |
| 10C  | WASHER, HEAD-MIDDLE CYLINDER        | * *   |
| 10D  | NUT, HEAD-MIDDLE CYLINDER           | * *   |
| 11   | DIAPHRAGM                           | 1     |
| 12   | PISTON, ACTUATOR                    | 1     |
| 13   | PISTON RING, ACTUATOR               | 1     |
| 13A  | BOLT, RING-PISTON                   | * *   |
| 13B  | LOCK WASHER, RING-PISTON            | * *   |
| 14   | STEM ACTUATOR                       | 1     |
| 14A  | "O"-RING, PISTON                    | 1     |
| 14B  | WASHER, PISTON-STEM                 | 1     |
| 14C  | LOCK NUT, PISTON-STEM               | 1     |
| 47   | COMPRESSION RETURN SPRING           | 1     |
| 47A  | BUTTON, SPRING                      | 1     |



- 47B. JACK BOLT, SPRING
- 47C. NUT, SPRING
- 47E. SET SCREW, SPRING

| ITEM | QUANTITY           |       |    |       |    |    |    |    |    |    |    |    |    |    |    |    |
|------|--------------------|-------|----|-------|----|----|----|----|----|----|----|----|----|----|----|----|
|      | PINCH VALVE BONNET |       |    |       |    |    |    |    |    |    |    |    |    |    |    |    |
| 2A   | 1                  | 1-1/2 | 2  | 2-1/2 | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 |
| 2B   | 8                  | 8     | 10 | 10    | 10 | 12 | 14 | 14 | 16 | 16 | 18 | 18 | 18 | 20 | 22 | 24 |
| 2D   |                    |       |    |       |    |    |    |    |    |    |    |    |    |    |    |    |

| ITEM | QUANTITY |    |    |    |     |     |
|------|----------|----|----|----|-----|-----|
|      | ACTUATOR |    |    |    |     |     |
| 9A   | 14       | 28 | 47 | 80 | 100 | 150 |
| 9B   |          |    |    |    |     |     |
| 9C   | 10       | 12 | 15 | 18 | 20  |     |
| 9D   |          |    |    |    |     |     |
| 10A  | 5        | 5  | 5  | 5  | 12  | 15  |

\* SEE "CHART NO.1"

\* \* SEE "CHART NO.2"



INSTALLATION & MAINTENANCE

(AIR-TO-OPEN, SPRING-TO-CLOSE)

The above listed Series of RKL pinch type valves are standard valve mechanisms with an air-to-open, spring-to-close actuator.

These series of valves have been completely assembled and tested and the spring tension adjusting bolt set for approximately 10% above the line pressure specified on your order. The valve is ready for installation as it is received.

These valves may be mounted in any position with flow in either direction.

Follow the installation and maintenance instructions attached for the particular type of open body or closed body construction furnished.

The Series L valves are furnished with an alemite lubricating fitting in the spool piece for lubrication every 10,000 cycles. The Series RAF and RA valves should be lubricated directly on the stem with a heavy grease once every 10,000 cycles.

If you want to increase the tension on the spring for a higher line pressure, thru the rubber body, the spring tension adjusting bolt may be screwed inwards after loosening the spring adjusting bolt lock nut.

There is a limit to the line pressure this valve will hold with the particular spring furnished you. If you cannot get tight shut off with this spring for an increased line pressure, contact the factory to see if a heavier spring is available for the size actuator you have. Remember, the further in you screw the spring tension bolt, the higher the air pressure required to open the valve.

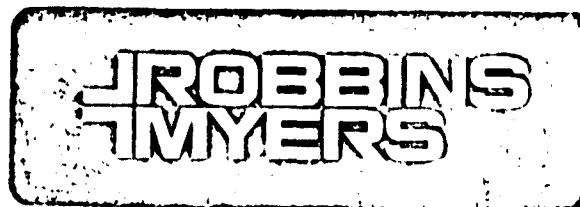
Be sure the vent hole in the spring cover is clear at all times.

The air hook up for this type air-to-open, spring-to-close valve is shown on the air hook up diagram attached.

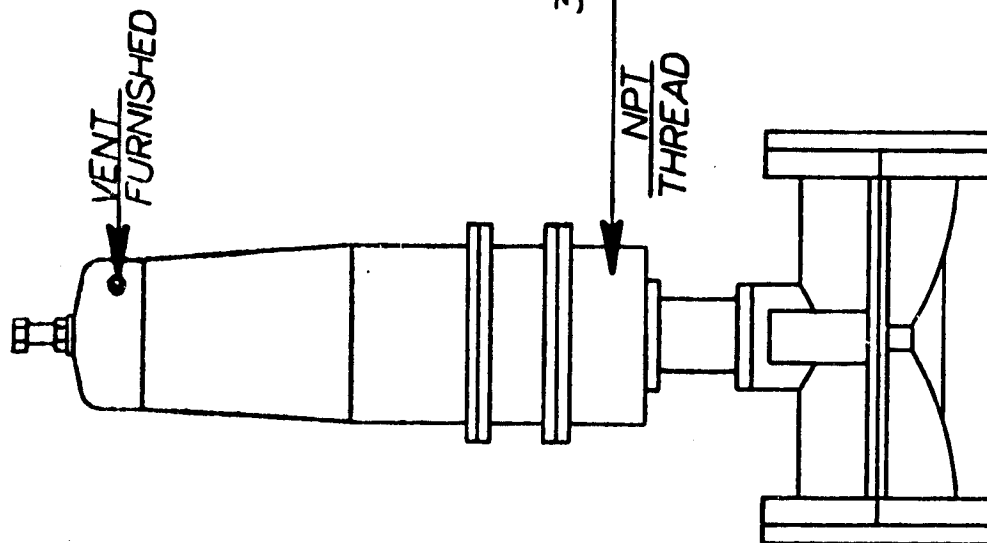
IF THE ABOVE INSTRUCTIONS ARE NOT FOLLOWED, ALL GUARANTIES AND WARRANTIES WILL BE VOID.

## RKL CONTROLS

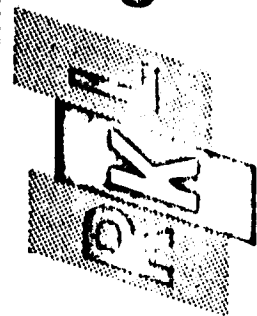
Robbins & Myers, Inc.  
P.O. Box 276, Ark Road  
Lumberton, NJ 08048  
Ph 609 267 2800 Telex 831-692



|                      |  |
|----------------------|--|
| VALVE SIZE & TYPE    |  |
| ACTUATOR SIZE & TYPE |  |
| BODY MATERIAL        |  |
| MAX. TEMP.           |  |
| LINE PRESSURE        |  |



AIR HOOKUP DIAGRAM FOR ATOSP ACTUATED VALVES



**CONTROLS, INC.**  
HAINESPORT INDUSTRIAL PARK  
HAINESPORT, N.J.

ORIGINAL PAGE IS  
OF POOR QUALITY

PUMPS

# H/HC

MOTORPUMPS/CRADLE MOUNTED  
CENTRIFUGAL PUMPS



## INSTRUCTIONS and PARTS LIST

NOTE: IT IS IMPORTANT THAT THE ENTIRE CONTENTS OF THIS BOOKLET BE STUDIED BEFORE INSTALLATION.



**Ingersoll-Rand.**

STANDARD PUMP - ALORICH DIVISION

Form SPAD-27D

## MAINTENANCE

**WARNING** Before attempting any inspection or repair on the pump the driver controls must be in the "off" position, locked and tagged to prevent injury to personnel performing service on the pump.

### DISASSEMBLY

The back withdrawal feature of the pump enables the complete unit to be dismantled without disturbing the pump casing and piping (also the driver, if a spacer coupling is used on the cradle mounted version).

1. Shut off all valves controlling liquid flow to and from the pump and disconnect electrical connections. Drain casing. Drain cradle (if oil lubricated).

**WARNING** Before attempting to disassemble pump, pump must be isolated from system, drained of liquid and cooled, if pump is handling hot liquid.

2. Disconnect seal flushing lines.



Figure 3

3. Remove spacer coupling. (Fig. 3)
4. Remove casing bolts and bearing housing support when furnished. The complete unit can now be withdrawn from the casing. (Fig. 4) (Including motor on H-motor pumps.)

**NOTE:**—On larger motor pumps some customers prefer to disconnect piping and remove casing, leaving motor undisturbed.



Figure 4

5. With the use of a gear puller withdraw the impeller after removing the retaining bolt (right hand thread) and washer. Be sure pullers are set against impeller vanes.
6. Remove gland nuts and withdraw gland on to shaft. If the unit is soft packed, remove the packing and lantern ring (See section on Packing Replacement).
7. Extract two bolts holding cradle or support head on motor pumps to casing cover. Withdraw casing cover. (Fig. 5)



Figure 5

8. Remove shaft sleeve (and mechanical seal if applicable).
9. **Cooled Cover Only**  
For pumps with cooled stuffing box covers, remove special gland studs. This is best accomplished by putting two nuts on the special stud and unscrewing the first against the second. Remove the stat-o-seals and withdraw the cooled cover.

**CAUTION:** On pumps for hot service furnished with a cooled stuffing box cover, if for any reason no cooling liquid is provided to the jacket, be sure to vent the jacket to prevent build-up of pressure.



Figure 6

10. To remove wearing rings for replacement, they must be split by using a cold chisel. (Fig. 6)



11. On cradle mounted units the shaft and bearings are removed by removing the bearing end covers and tapping shaft through.

### CLEANING AND INSPECTION

**WARNING** Do not attempt any maintenance, inspection, repair or cleaning in the vicinity of rotating equipment. Such action could result in personal injury to operating personnel.

Discard gaskets and packing as new parts must be used during assembly. All parts must be clean before assembly. This is particularly important at threads, gasket surfaces and radial fit contact areas.

**NOTE:** Ingersoll-Rand assumes no responsibility or liability for damages caused by the use and failure of the pump which has been fitted with spare or repair parts not of Ingersoll-Rand manufacture. Only genuine parts from Ingersoll-Rand or an authorized Distributor should be used.

Inspect impeller for excessive wear or scoring particularly in wearing areas. Wearing ring clearances should be between .010-.017" diametrically. Check that threads are clean. Ensure that the keyway is not damaged. Check shaft for straightness and corrosion. Check that impeller and coupling fit is between .000 and .002" loose. Check shaft sleeve for straightness and wear, particularly on soft packed units. Excessive wear or grooves will lead to unacceptable leakage.

Examine keyways and keys. Keys should be snug fitting, but not tight. Examine stuffing box wearing rings and ensure that no wear or scoring has taken place. Check circumferential mating areas for burrs etc. Remove old gasket material and clean up face. Examine the internal bore of the stuffing box to ensure cleanliness and that there is no build up of deposits. Check all threads and tapped holes for burrs.

Inspect surface of gland that contacts packing to be sure that it is clean and smooth. On mechanical seal glands, remove old gasket material and check inside diameter of glands. Inspect coupling keyways. Inspect casing wearing rings for wear and scoring and replace if necessary. Check casing mating surfaces for burrs and remove any old gasket material. Check casing for corrosion and thoroughly clean.

On cradle pumps check that shaft end play is between .002 and .016". On motor pump versions, check the motor shaft extension against the following table. Should any of the limits be exceeded check with the motor manufacturer for recommended repair or replacement parts.

| FRAMES    | RABBET<br>ECCENTRICITY | FACE<br>RUN OUT | SHAFT<br>RUN OUT |
|-----------|------------------------|-----------------|------------------|
| 143 - 256 | .004 TIR               | .004 TIR        | .002 TIR         |
| 284 - 365 | .006 TIR               | .006 TIR        | .003 TIR         |

### RE-ASSEMBLY PROCEDURE

**NOTE:**—For H motor pumps steps 1, 2 and 3 do not apply and the support head should be bolted to the motor prior to step 4.

1. Slide bearing on to shaft as far as possible by hand.

Light oil lubrication of the shaft will help. Tap or press bearings up to locate shoulders. Do not use excessive force if bearings are being tapped onto shaft as this may damage the races and reduce bearing life.

Heat must not be used particularly on grease packed bearings as the lubrication properties of the grease may be impaired

2. Place shaft and bearing assembly into cradle. Lightly lubricate bearing outside diameter and tap into place if necessary.
3. Bolt bearing end covers to cradle. For oil lubricated units, place lip seals in position in end covers.
4. Position seal stationary sealface and gasket in gland (mechanical seal only) and place gland on shaft. Position seal on sleeve and fit out to shaft.
5. If applicable locate wearing ring into casing cover. This is a light interference fit, and should be pressed in. Cooling the wearing ring in a freezer will assist the operation.
6. **Cooled Cover Only**  
For pumps with cooled stuffing box covers position gasket and o-ring after making sure seating surfaces and o-ring groove are clean. Refer to page 12 or 14 for proper positioning of gaskets.  
Assemble cooling cover to casing cover and place stat-o-seals on special gland studs. Tighten the special gland studs using double nut method described in Disassembly, paragraph 9. The cooling cover is now clamped into position.
7. Position casing cover on shaft and bolt to cradle (support head on motor pumps).
8. Locate impeller drive key and then bolt impeller into position. Ensure that the drive key is located correctly into the shaft sleeve.
9. Replace casing ring if necessary. Replace gasket, bolt complete assembly to the pump case. Refer to table 2—page 6 for casing bolt torque values.
10. Bolt gland into position.
11. Assemble bearing housing support (when furnished) with bearing housing and bed.
12. Before starting unit be certain that the impeller rotates freely.

### REPLACEMENT OF MECHANICAL SEAL

Mechanical seals should be checked, particularly during the first hours of operation. Minor leakage through the seal usually stops after a short time, however if it continues, stop the pump and examine the seal. Excessive leakage past a mechanical seal usually indicates worn or broken parts, which require replacement.

To replace a mechanical seal the pump must be dismantled (See Disassembly). The stationary part of seal must be removed from the gland and replaced by a new part.

Remove the gasket from the seal cover, thoroughly clean gland and replace gaskets.

Setting of the replacement seal should be carried out in accordance with the seal drawing that is provided with the

unit. With John Crane Type 1 the setting is automatic since the seal is located against a shoulder on the sleeve.

### REPLACING SOFT PACKING

When packing becomes worn to the extent that leakage cannot be controlled within desirable limits, it is advisable to repack the stuffing box.

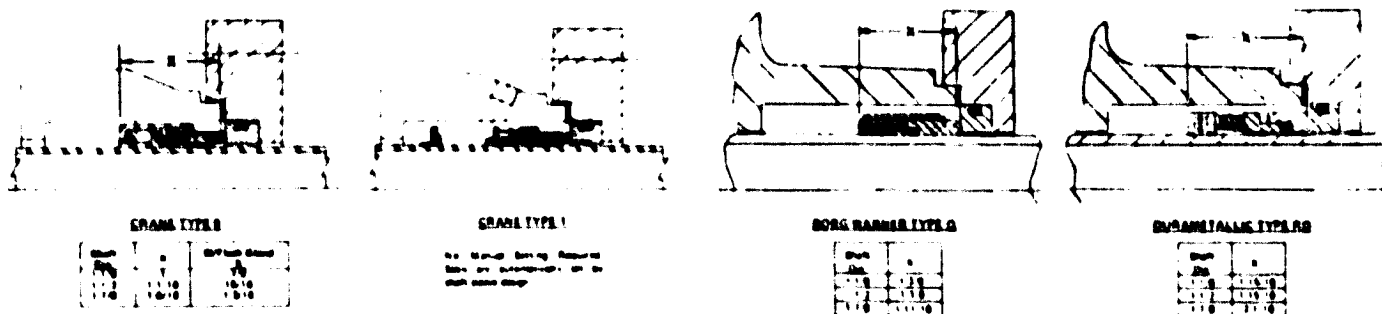
1. Remove bolts securing gland, and withdraw gland
2. With the aid of a hook, pull the packing and seal cage ring from the stuffing box.
3. Thoroughly clean stuffing box and inspect sleeve be-

fore repacking. Leakage may be due to a worn sleeve requiring replacement.

4. Install two (2) rings of packing, ensuring that joints are staggered.
5. Insert Seal Cage. (If used)
6. Insert three rings (four if seal cage is not used) of packing.
7. Insert gland nuts and draw down finger tight. Ensure that the nuts have been tightened evenly, then tighten nuts an extra 1/4 turn to initially set the packing.

## SEAL TYPES AND SETTINGS

SETTING DIMENSIONS APPLY TO O-RING SEATS OR SEATS WITH TEFLON WEDGES IN ALL CASES.



## ORDERING INSTRUCTIONS

BY GIVING COMPLETE INFORMATION, YOU WILL ENABLE US TO  
FILL YOUR ORDER CORRECTLY AND AVOID UNNECESSARY DELAYS

### HOW TO ORDER REPLACEMENT PARTS

When ordering replacement parts, please specify

1. The **SIZE & TYPE**, and **SERIAL NUMBER** as stamped on the **PUMP** name plate. (The Size is the numerical prefix to the Type).
2. The **FORM NUMBER** of this booklet (FORM SPAD-27)
3. The **QUANTITY**.
4. The **PART NUMBER** and **DESCRIPTION** exactly as listed

#### EXAMPLE

2-1/2 x 1-1/2 x 12 HC SERIAL No. 0272 4502  
FORM SPAD 27C  
1 - CASING - 2469  
1 - IMPELLER - 1129

### HOW TO ORDER MOTOR PARTS

Complete motor & motor parts shown in the parts list must be procured from I-R.

### HOW TO

### SELECT

### *Recommended Spares*

Each Parts List shows the parts which are included in each of the following three classes of recommended spares

**CLASS 1 - MINIMUM** - Suggested for Domestic Service when pump is handling clean, noncorrosive liquids and where interruptions in service are not important

**CLASS 2 - AVERAGE** - Suggested for Domestic Service when pump is handling abrasive or corrosive liquids and where some interruptions in continuity of service are not objectionable

**CLASS 3 - MAXIMUM** - Suggested for Export Marine or Domestic Service where interruptions in service are objectionable.

Our Sales Representative in your area will gladly review the class of spares best suited to meet your requirements

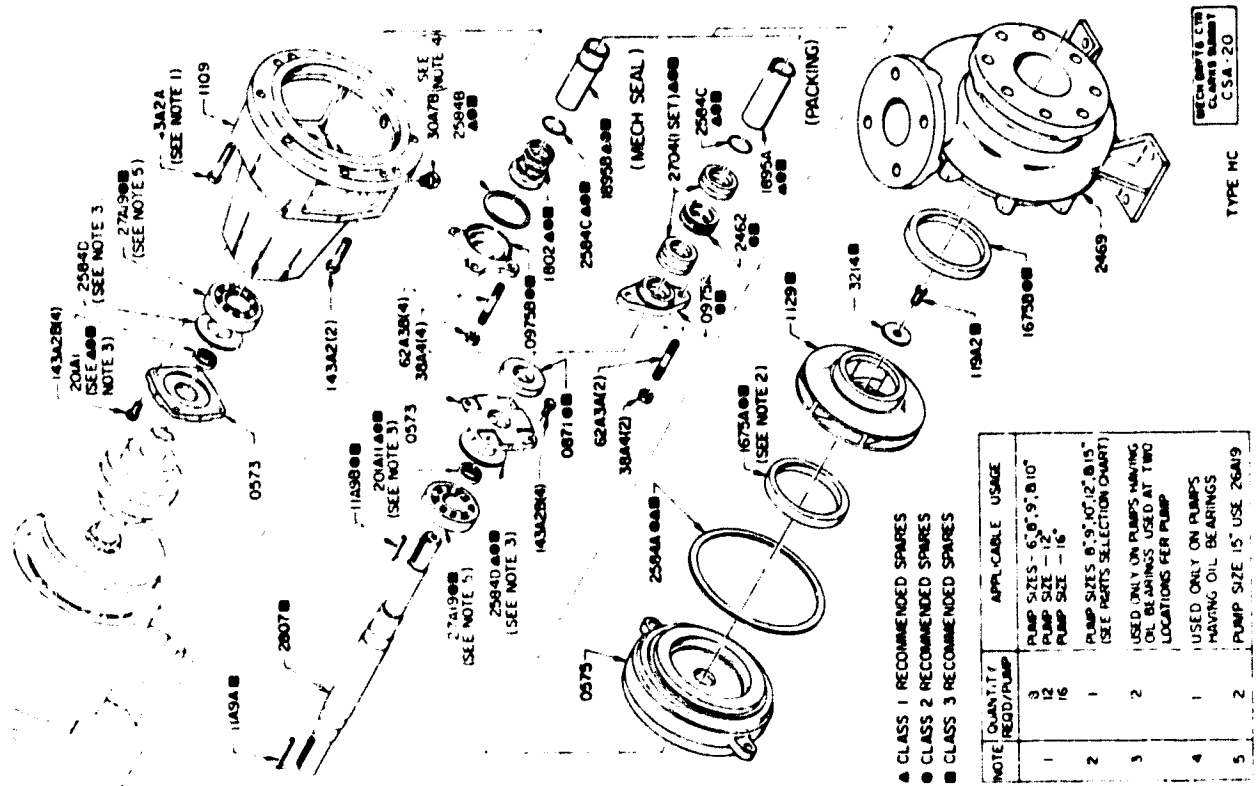
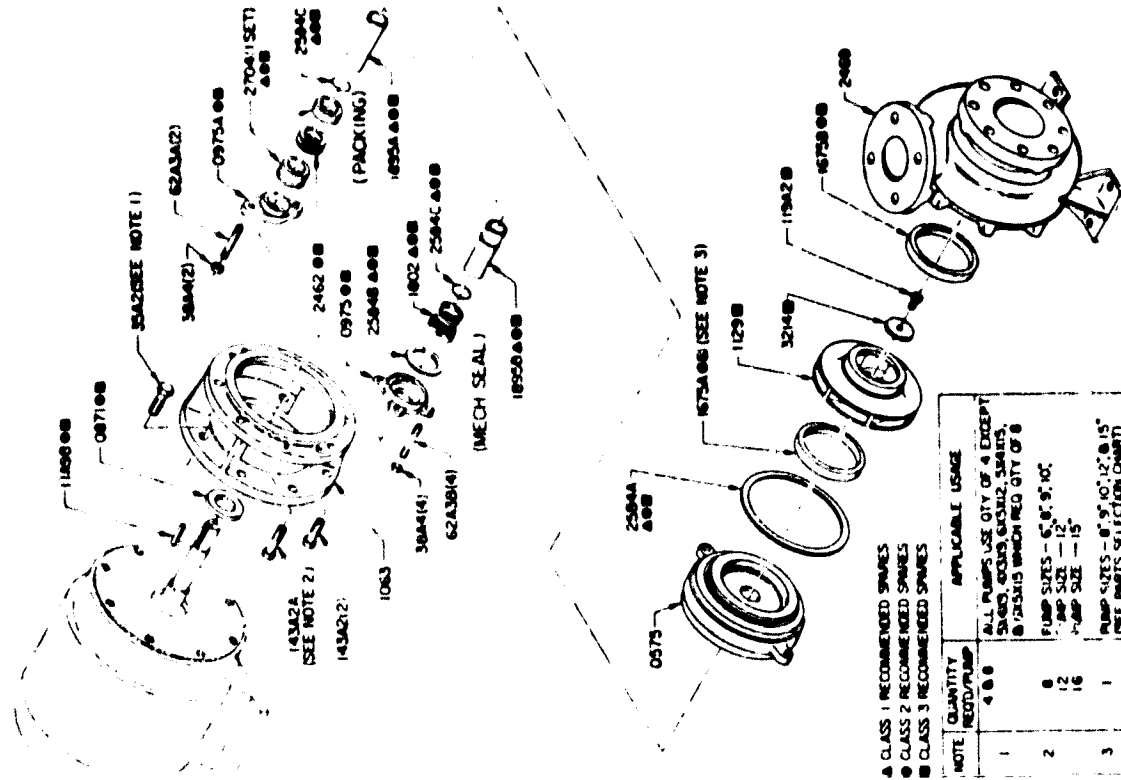
When ordering recommended spares, please follow the procedure as outlined for replacement parts

### - IMPORTANT -

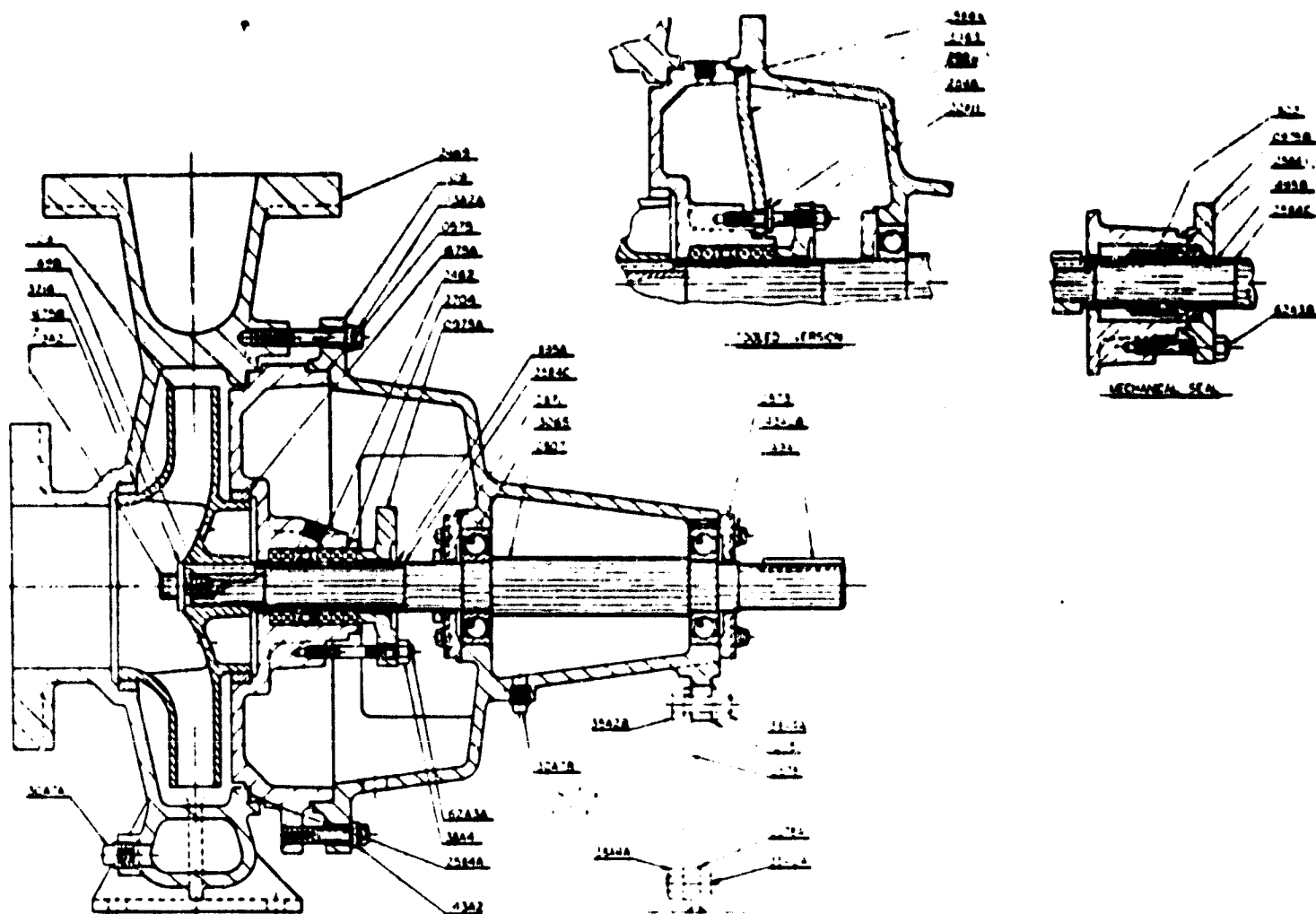
When ordering motor parts, always give the Motor Serial Number and the Model Number as read from the motor name plate. Also furnish the Pump Serial Number.

**REFER ALL COMMUNICATIONS TO THE NEAREST ADDRESS LISTED ON THE BACK COVER  
OR TO THE NEAREST INGERSOLL-RAND DISTRIBUTOR**

# H/HC EXPLODED VIEW DRAWINGS



# HC CRADLE MOUNTED PUMP CROSS SECTIONS AND PARTS LIST



| Part   | Name of Part               | Part   | Name of Part        |
|--------|----------------------------|--------|---------------------|
| 0573   | End Cover                  | 2846   | Stud (Special)      |
| 0575   | Stuffing Box Cover         | 3214   | Washer              |
| 0871   | Flinger                    | 3463   | Cooling Cover       |
| 0975A  | Gland (Packed Box)         | 11A9A  | Key (Driver)        |
| 0975B  | Gland (Mech Seal)          | 11A9B  | Key (Impeller)      |
| 1109   | Bearing Housing            | 12A5°  | Washer              |
| 1129   | Impeller                   | 20A11  | "O" Ring            |
| 1675A  | Ring (Stuffing Box Cover)  | 27A19  | Bearings            |
| 1675B  | Ring (Casing)              | 30A7A  | Pipe Plug           |
| 1802   | Mechanical Seal (Complete) | 30A7B  | Pipe Plug           |
| 1895A  | Sleeve (Packed Box)        | 35A2A° | Capscrew            |
| 1895B  | Sleeve (Mech Seal)         | 35A2B° | Capscrew            |
| 2462   | Seal Cage                  | 38A4   | Nut                 |
| 2439   | Casing                     | 38A4A  | Nut                 |
| 2578°  | Bearing Housing Foot       | 62A3A  | Stud (Stuffing Box) |
| 2578A° | Bearing Housing Foot       | 62A3B  | Stud (Mech Seal)    |
| 2584A  | Gasket (Casing)            | 119A2  | Capscrew (Impeller) |
| 2584B  | Gasket (Seal)              | 143A2  | Capscrew            |
| 2584C  | Gasket (Sleeve)            | 143A2A | Capscrew            |
| 2704   | Packing                    | 143A2B | Capscrew            |
| 2807   | Shaft                      | 252A11 | Stat O-Seal         |

\*Optional not shown.

Auxillary Electric Boiler

(Hot Water Heater)



**PEERLESS**  
OF BOYERTOWN, PENNSYLVANIA  
SINCE 1908

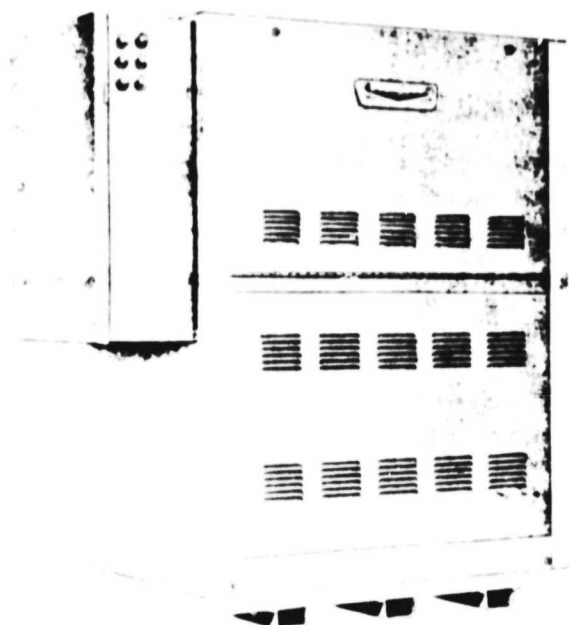
CAST IRON

**SERIES**

**peb**

**Hydronic Electric**

**BOILERS**



Series PEB-3-45  
Rated: 461,000 BTU/Hr. Output

*a new design...*

FOR  
**INDUSTRIAL  
COMMERCIAL  
RESIDENTIAL**

*Hydronic Heating*

**STEAM &  
WATER**

Cast Iron Block Assembly  
with electric heating elements

## 12 SIZES

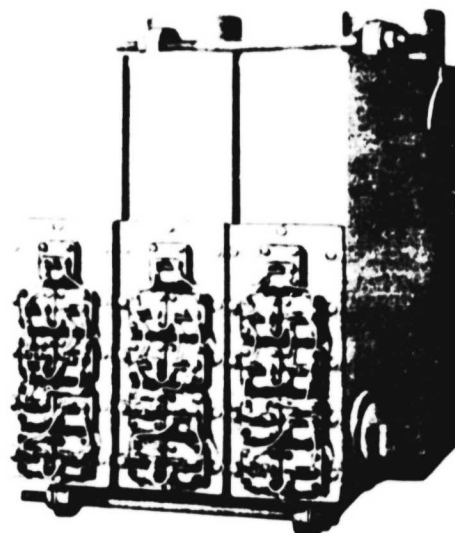
**RATED: 102,500 to 1,536,800 BTU/hr. Output**

Factory assembled, wired and packaged,  
ready for installation.

### Heating At Its Best

The Series PEB Cast Iron Electric Boiler incorporates many outstanding engineering and design features in keeping with modern day industrial, commercial and residential plans, when central hydronic heating is desired.

The right is reserved by the manufacturer to make changes at any time without notice.



**THE PEERLESS HEATER COMPANY**

DIV. OF PEERLESS INDUSTRIES, INC.

BOYERTOWN, PENNSYLVANIA 19512

190

**PEERLESS  
HEAT**

SINCE 1908

## ELECTRIC BOILER DATA

Boiler Model No.: PEB-8-45W

Description: 480/60/3 - Proportional Temperature Control (8 Stages) with Immersion Sensor - 30 P.S.I.G. W.W.P.

Boiler Size - KW: 360

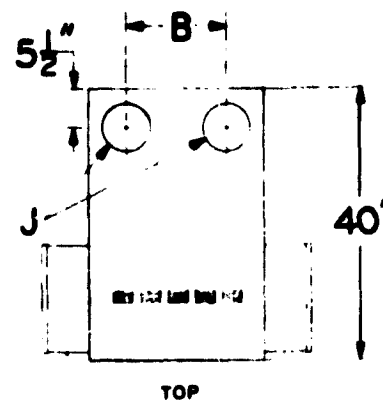
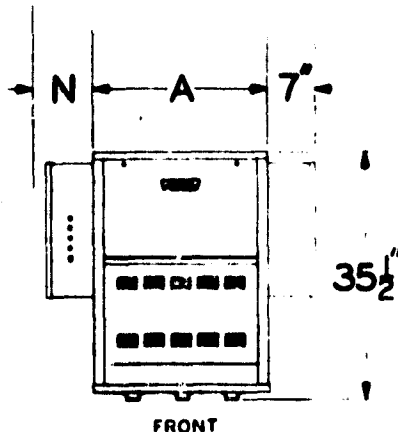
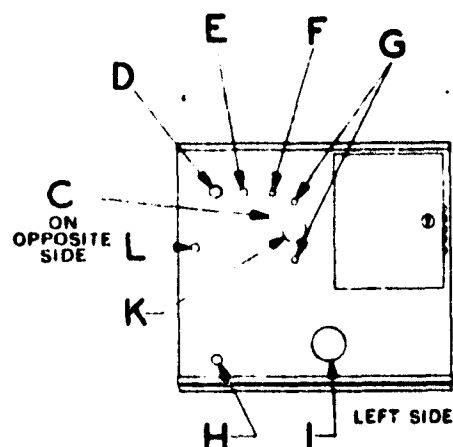
Gross Output - MBH: 1229.4

Net Water - MBH: 1069.6

Net Water - Sq.Ft.: 7130

Shipping Weight - Lbs.: 3277

| <u>PART</u>            | <u>SUPPLIER</u>  | <u>PART NUMBER</u>      | <u>QUANTITY</u> |
|------------------------|------------------|-------------------------|-----------------|
| Control Transformer    | Acme Electric    | TA-81213-250VA          | 1               |
| Theraltimeter          | Ametek           | 84877-3 1/2" Sq.        | 1               |
| Time Delay Relay       | Amperite         | 115N015                 | 7               |
| Octal Base             | Bell Industrial  | 8QR                     | 7               |
| Mounting Track         | Bell Industrial  | TK2-12-14"              | 1               |
| Line Fuse              | Buss             | JKS-15AMP-600 Volt      | 2               |
| Heating Element        | J.V. Calhoun     | TG-2507-16"-5KW-480V.   | 72              |
| Element Gasket         | J.V. Calhoun     | 2-16717                 | 72              |
| Class J Fuse           | Chase Shawmut    | A4J30-30AMP (AMP-Trap)  | 24              |
| Class J Fuse           | Chase Shawmut    | A4J60-60AMP (AMP-Trap)  | 24              |
| Indicator Light        | Dialight Corp.   | 135-5763-1431-311 Red   | 8               |
| Indicator Light        | Dialight Corp.   | 135-5763-1433-311 Amber | 1               |
| Neon Glow Lamp         | Dialight Corp.   | B2A(NE-51H)T-3-1/4"     | 9               |
| High Limit Control     | Honeywell        | L4006A1058              | 1               |
| Contactor              | I.T.E. Rowan     | 2200-EB-430AA-76        | 8               |
| Contactor              | I.T.E. Rowan     | 2200-EB-430AA-77        | 1               |
| Contactor              | I.T.E. Rowan     | 2200-EB-430AA-1-77      | 7               |
| Low Water Cut-Off      | McDonnell-Miller | 764                     | 1               |
| Immersion Sensor       | Penn Controls    | A91AAA-11               | 1               |
| Actrol Staging Control | Penn Controls    | R20AB-3                 | 1               |
| Signal Center          | Penn Controls    | R21AD-1                 | 1               |
| 120-24V Transformer    | Penn Controls    | Y64AL-2-100VA           | 1               |
| Pressure Relief Valve  | Watts            | 740-1"-30#-1300 MBH     | 1               |



NOTE: In addition to the left Terminal Box, a right Terminal Box is furnished on Models PEB-4 through PEB-6, 208/240 volts; Models PEB-8 through PEB-10, 480 volts.

### Series PEB—RATINGS & DIMENSIONS

| Boiler Model No. | Boiler Size KW | Gross Output MBH | Net Rating* |                 |           |               | No. of 5 KW Heater Elements | *** Rated Voltage 3 Phase | *** Rated Amps 3 Phase | Dimensions |         |                        |                  |
|------------------|----------------|------------------|-------------|-----------------|-----------|---------------|-----------------------------|---------------------------|------------------------|------------|---------|------------------------|------------------|
|                  |                |                  | Water MBH   | Water** Sq. Ft. | Steam MBH | Steam Sq. Ft. |                             |                           |                        | "A"        | "B"     | "N"                    |                  |
|                  |                |                  |             |                 |           |               |                             |                           |                        |            |         | With 67-PE or 764 LWCO | With 47-2 Feeder |
| PEB-1-30         | 30             | 102.5            | 89.6        | 600             | 77.3      | 320           | 6                           | 208/240/480               | 83.72/36               | 11"        | —       | 7"                     | 9"               |
| PEB-1-45         | 45             | 153.7            | 133.9       | 895             | 115.5     | 480           | 9                           | 208/240/480               | 125/108.54             | 11"        | —       | 7"                     | 9"               |
| PEB-2-30         | 60             | 204.9            | 178.3       | 1190            | 153.8     | 640           | 12                          | 208/240/480               | 167/144.72             | 18 3/8"    | 7 1/8"  | 7"                     | 9"               |
| PEB-2-45         | 90             | 307.4            | 267.0       | 1780            | 230.3     | 960           | 18                          | 208/240/480               | 250/216.108            | 18 3/8"    | 7 3/8"  | 7"                     | 9"               |
| PEB-3-45         | 135            | 461.0            | 401.7       | 2680            | 346.6     | 1445          | 27                          | 208/240/480               | 375/325.163            | 25 3/8"    | 14 3/4" | 7"                     | 9"               |
| PEB-4-45         | 180            | 614.7            | 533.9       | 3560            | 460.6     | 1920          | 36                          | 208/240/480               | 500/433.217            | 33 1/8"    | 22 1/8" | 7"                     | 9"               |
| PEB-5-45         | 225            | 768.4            | 667.8       | 4450            | 576.1     | 2400          | 45                          | 208/240/480               | 625/542.271            | 40 1/2"    | 29 1/8" | 7"                     | 9"               |
| PEB-6-45         | 270            | 922.1            | 801.7       | 5345            | 691.7     | 2880          | 54                          | 208/240/480               | 750/650.325            | 47 1/8"    | 36 1/8" | 7"                     | 9"               |
| PEB-7-45         | 315            | 1075.7           | 935.7       | 6240            | 807.2     | 3365          | 63                          | 480                       | 380                    | 55 1/4"    | 44 1/4" | 7"                     | 9"               |
| PEB-8-45         | 360            | 1229.4           | 1063.6      | 7130            | 922.7     | 3845          | 72                          | 480                       | 434                    | 62 5/8"    | 51 5/8" | 7"                     | 9"               |
| PEB-9-45         | 405            | 1383.1           | 1203.5      | 8025            | 1047.7    | 4365          | 81                          | 480                       | 488                    | 70"        | 59"     | 7"                     | 9"               |
| PEB-10-45        | 450            | 1536.8           | 1335.7      | 8905            | 1174.3    | 4895          | 90                          | 480                       | 542                    | 77 1/8"    | 66 1/8" | 7"                     | 9"               |

\*Net ratings are based on L-B-R piping and pick-up factors for automatically fired boilers

\*\*Net rating is based on net rating in BTU per hour at 170° boiler water temperature with heat emission of 150 BTU/sq. ft.

\*\*\*For single phase PEB-1-30, 240V and 125 Amps. PEB-1-45, 240V and 188 Amps. PEB-2-30, 240V and 250 Amps.

NOTE: On multiple boiler installations, allow at least 30" between boilers for servicing

### SERIES PEB ELECTRIC BOILER

#### TAPPING LOCATION, SIZE & USE

| LOCATION | SIZE NPT | STEAM             | WATER                     |
|----------|----------|-------------------|---------------------------|
| C        | 3/4"     | —                 | Auxiliary Limit Control   |
| *D       | 1 1/2"   | Pop Safety Valve  | Relief Valve              |
| E        | 3/4"     | —                 | Limit & Operating Control |
| F        | 1/2"     | Steam Gauge       | Theralltometer            |
| G        | 1/2"     | Low Water Cut-Off | —                         |
| *H       | 1"       | Boiler Drain      | Boiler Drain              |
| *I       | 4"       | Return            | Return                    |
| J        | 3"       | Supply            | Supply                    |
| K        | 2 1/2"   | —                 | Low Water Cut-Off         |

\*AUXILIARY TAPPING ON OPPOSITE SIDE.

#### WORKING PRESSURE:

50 LBS. WATER  
15 LBS. STEAM  
80 LBS. WATER (Available)

Manufactured Laboratories Inc.  
LISTED



### SERIES PEB ELECTRIC BOILERS

#### STANDARD EQUIPMENT: (WATER)

- Deluxe type steel insulated jacket
- Limit & operating control
- Low water cut-off
- Pressure relief valve A S M E 30 lb.
- Power supply terminal box(es)
- Control transformer
- Theralltometer
- Drain cock
- Combination magnetic contactors & fuse blocks
- Flange type immersion element's sheathed in copper alloy
- Time delay relays - 15 second
- Completely wired & assembled

POWER SUPPLY TERMINAL BOX INCLUDES POWER SUPPLY TERMINAL BLOCK, PILOT LIGHTS INDICATING EACH STAGE, POWER "ON-OFF" SWITCH WITH LIGHT, CONTROL TRANSFORMER, TIME DELAY RELAYS

#### STANDARD EQUIPMENT: (STEAM)

Same as water except, pressure limit control, pressure operating control, compound steam pressure gauge in lieu of theralltometer, A S M E. pop safety valve (side outlet) 15 lb. in lieu of water pressure relief valve, gauge glass set

#### OPTIONAL EQUIPMENT:

Sequencing indoor-outdoor control, combination pump and low water cut-off control (steam only) combination low water cut-off feeder

DISTRIBUTED BY:

## G — STARTING THE BOILER

### 1—PRE-START UP

- IMPORTANT**—On Steam boilers be sure boiler and system has been cleaned properly to insure against surging or boiler priming. The method for cleaning is described in the attached CARE AND OPERATION OF PEERLESS BOILERS. After cleaning, fill boiler to the prescribed water line height of 24" above the floor.
- On Water boilers, be sure the system has been filled with water and vented free of air.
- Check all electrical connections as some may have loosened in shipment.
- Check to see that all fuses are in place.

### 2—START-UP

- Set the thermostat or operating control to desired setting.
- Close the main power switch.
- Close the "Power" switch in the Terminal Box.
- Boiler is now in an operating condition.

## H — SERVICE AND MAINTENANCE

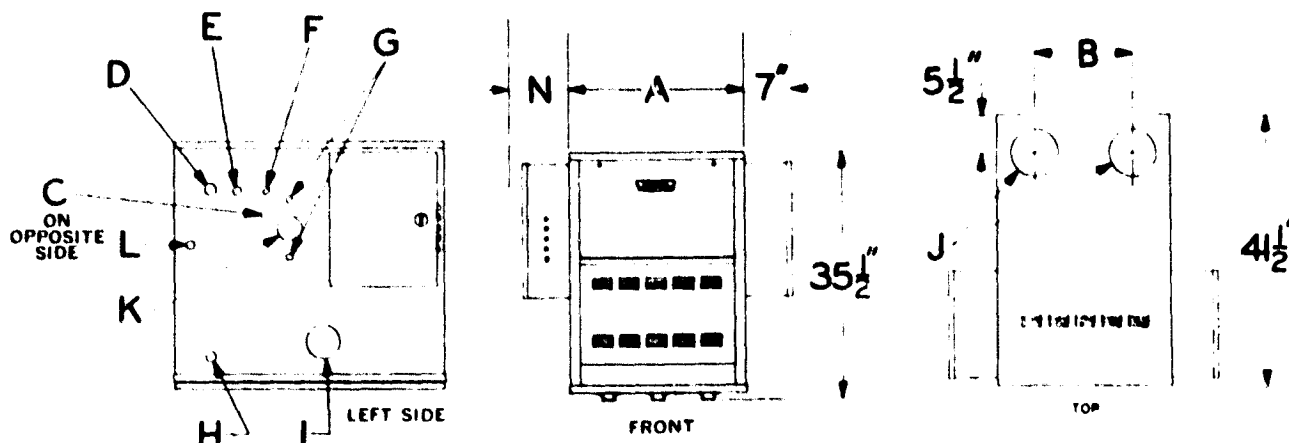
- Do not maintain a higher temperature than is necessary to comfortably heat the building.
- On a water boiler, if it is necessary to add water in excess of  $\frac{1}{2}$  lb. gauge pressure per month, check for leaks and correct immediately. If water is required to renew the water line in a steam boiler at least once a month also check for leaks and correct immediately. Excessive introduction of make up water may result in the formation of lime scale and sludge on the heater elements, which will reduce the life and effectiveness of the heating elements.
- If it is necessary to clean or replace the heating elements, drain the boiler and system. Disconnect the wiring to each element separately and remove the element from the boiler. Clean or replace element, reinstall it in the boiler and rewire it before removing the next element. This will avoid getting the wiring mixed. To clean the elements, use a brush and detergent solution to remove all sludge and lime scale deposits.

When reinstalling the elements be sure to use new gaskets behind the element flanges

- From time to time the contacts on the contactors may become dirty or burned and fail to transfer power to the heating elements. Cleaning of the contacts can be accomplished by drawing a piece of hard card stock (file card or calling card) between the contacts or use a contact burnishing tool. If the contacts are burned badly, the contactor should be replaced.
- There is no positive way of telling whether a heating element has burned out without testing the element continuity. It is therefore suggested that at least twice a heating season the continuity of the elements be checked. A simple continuity meter or indicator is all that is required. If the needle on the meter does not register when the probes touch the two element terminals, the element is then defective.

A blown fuse would also indicate an element failure, however, a continuity test would still be required to determine which one actually has failed as the elements are grouped together in a delta connection.

**NOTE:** When inspecting the heating element and it is noted the sheathing has disintegrated; this is a direct indication the element was not covered by water. The low water cut-off function should then be checked and also check for the possibility of air trapped in the boiler and around the elements

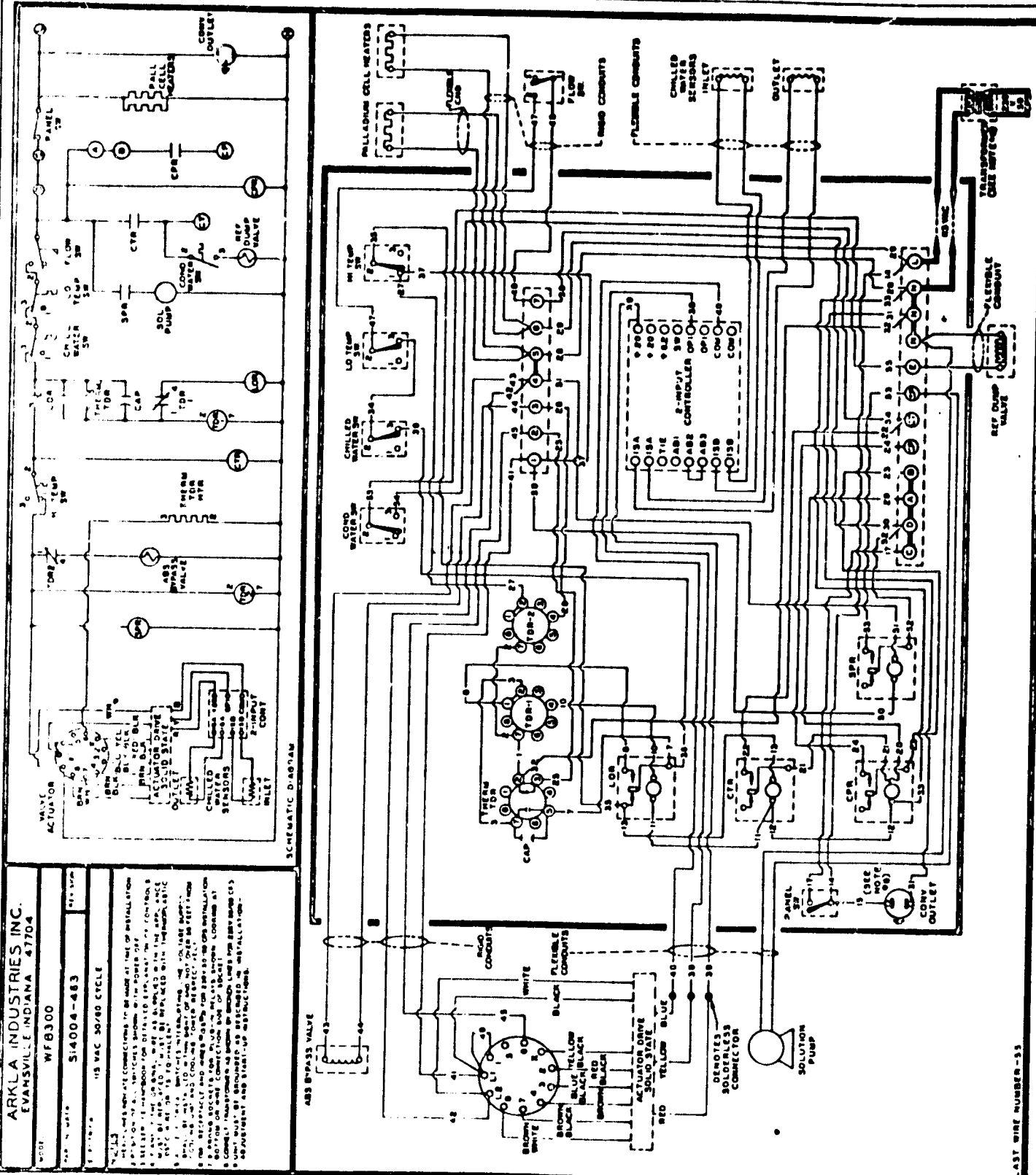


**NOTE:** In addition to the left Terminal Box, a Right Terminal Box is furnished on Models PEB-5 and PEB-6, 240 volts, Models PEB-8 through PEB-10, 480 volts

Figure 14

DATE: Jan., 1977

MODELS  
WFB-300



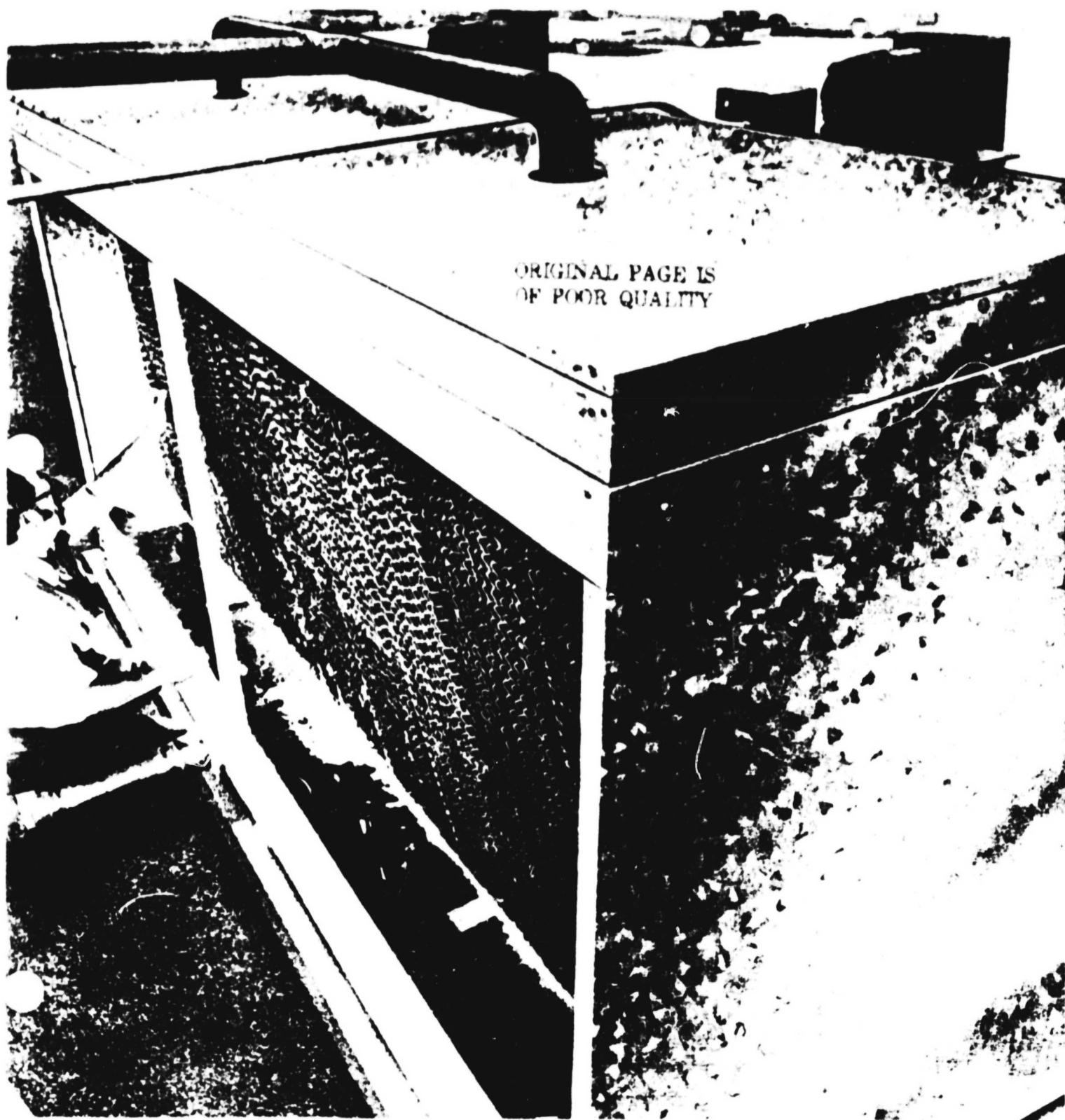


COOLING TOWER

*Ken Wicks*

*215-565-0628*

HALSTEAD & MITCHELL  
**COOLING  
TOWERS**  
WITH FIREPROOF  
ASBESTOS FILL



## NEW HALSTEAD & MITCHELL COOLING TOWERS PROVIDE UP TO 25% MORE COOLING CAPACITY with no increase in cabinet size.

### ASBESTOS WETTED DECK SURFACE

The inorganic and incombustible wetted deck surface is impervious to fungus growth and other decay organisms. In addition to adding more cooling capacity with no increase in size, the lightweight decking also helps our cooling towers outperform other types of decking. You're assured of a cooling tower to meet your exact specifications.

No fill surface used commercially today provides as much water cooling capacity per cubic foot as does H&M's new asbestos wetted deck.

### LARGE CAPACITY SUMP

Constructed of heavy gauge steel. Welded throughout to eliminate leaks. Extra large volume sump accommodates water supply.

### LOW NOISE LEVEL FANS

The deep pitch, slow-speed fans cut noise level to a minimum. The long-lasting, zinc-plated, chrome-dip finish protects the heavy steel blades against corrosion.

### LIFE-LUBRICATED BEARINGS

Fan bearings are factory lubricated and permanently sealed for exceptional moisture resistance. Maintenance is reduced to a minimum. The bearing housing is durable malleable iron.

### WEATHER-RESISTANT MOTORS

The motors are suitable for outdoor operation and laboratory-approved for most adverse voltage and loading conditions. Weather shield for pulley and belt permits use even in icing conditions.

### WATER LEVEL CONTROL

A brass float valve maintains proper water level in the sump. The float ball is tough, corrosion-resistant plastic.

### CABINET CONSTRUCTION AND FINISH

Tower sides are constructed of galvanized steel. The sump is given special protection.

GCKA Models are shipped assembled but feature knock down design.

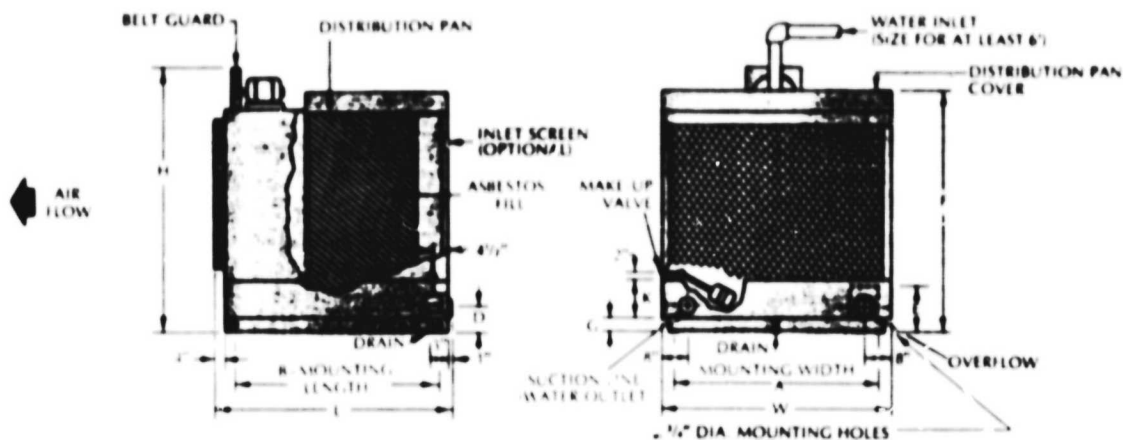
### OPTIONAL ACCESSORIES

- Motor hood
- Outlet water screen
- Inlet air screen
- Stainless steel fans

**TABLE 1 - GCKA COOLING TOWER PERFORMANCE - TONS OF REFRIGERATION\***

|   | HOT WATER, °F  | 90    | 95    | 87    | 95    | 92    | 96    | 97    | 95    | 97    | 95    | 96    | 96    |
|---|----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|   |                |       |       |       |       |       |       |       |       |       |       |       |       |
|   |                |       |       |       |       |       |       |       |       |       |       |       |       |
|   |                |       |       |       |       |       |       |       |       |       |       |       |       |
| 3 GPM/TON<br>COOLING TOWER<br>MODEL NUMBER GCKA | COLD WATER, °F | 80    | 85    | 77    | 85    | 82    | 86    | 87    | 85    | 87    | 85    | 86    | 86    |
|   | WET BULB, °F   | 65    | 70    | 70    | 72    | 72    | 73    | 75    | 75    | 78    | 78    | 79    | 80    |
|   | 5              | 7.3   | 8.3   | 4.3   | 7.5   | 5.9   | 7.5   | 7.2   | 6.5   | 6.0   | 5.0   | 5.0   | 4.5   |
|   | 7 1/2          | 11.0  | 12.5  | 6.3   | 11.0  | 8.7   | 11.5  | 11.0  | 9.5   | 9.0   | 7.5   | 7.5   | 7.0   |
|   | 10             | 14.8  | 16.5  | 8.5   | 15.0  | 11.8  | 15.2  | 14.5  | 12.5  | 12.0  | 10.0  | 10.0  | 9.2   |
|   | 15             | 22.3  | 24.8  | 12.6  | 22.5  | 17.8  | 22.5  | 22.0  | 19.0  | 18.5  | 15.0  | 15.5  | 14.0  |
|   | 20             | 29.9  | 33.3  | 17.0  | 30.2  | 23.9  | 30.5  | 29.5  | 25.5  | 24.7  | 20.0  | 20.5  | 18.5  |
|   | 25             | 37.7  | 41.4  | 21.0  | 37.5  | 29.5  | 38.0  | 36.5  | 31.5  | 30.5  | 25.0  | 25.5  | 23.2  |
|   | 30             | 44.3  | 49.5  | 25.0  | 44.5  | 35.5  | 45.5  | 44.0  | 37.7  | 36.7  | 30.0  | 30.5  | 27.7  |
|   | 40             | 59.0  | 66.0  | 33.3  | 59.5  | 47.3  | 61.0  | 58.7  | 50.5  | 49.0  | 40.0  | 40.5  | 37.0  |
|   | 50             | 73.9  | 82.5  | 41.8  | 75.0  | 59.0  | 76.0  | 73.5  | 63.0  | 61.0  | 50.0  | 51.0  | 46.0  |
|   | 60             | 89.0  | 99.0  | 50.0  | 89.0  | 71.0  | 91.0  | 86.5  | 75.0  | 72.0  | 60.0  | 60.0  | 54.0  |
|   | 75             | 110.0 | 125.0 | 63.0  | 110.0 | 87.0  | 115.0 | 110.0 | 95.0  | 90.0  | 75.0  | 75.0  | 70.0  |
|   | 100            | 148.0 | 165.0 | 83.6  | 150.0 | 118.0 | 152.0 | 145.0 | 124.0 | 122.0 | 100.0 | 101.0 | 90.0  |
|   | 120            | 178.0 | 198.0 | 100.0 | 180.0 | 141.0 | 182.0 | 174.0 | 149.0 | 146.0 | 120.0 | 121.0 | 108.0 |
|   | 150            | 222.0 | 247.0 | 125.0 | 224.0 | 176.0 | 228.0 | 217.0 | 186.0 | 182.0 | 150.0 | 151.0 | 134.0 |
| 4 GPM/TON<br>COOLING TOWER<br>MODEL NUMBER GCKA | HOT WATER, °F  | 82.5  | 85    | 89    | 89.5  | 95    | 93.5  | 95    | 93.5  | 95    | 95    | 95    | 97    |
|   | COLD WATER, °F | 75    | 77.5  | 81.5  | 82    | 87.5  | 86    | 87.5  | 86    | 87.5  | 87.5  | 87.5  | 89.5  |
|   | WET BULB, °F   | 65    | 70    | 70    | 72    | 72    | 75    | 75    | 78    | 78    | 79    | 80    | 80    |
|   | 5              | 4.7   | 4.2   | 6.3   | 5.7   | 8.2   | 6.3   | 7.2   | 5.5   | 6.2   | 5.3   | 5.3   | 5.2   |
|   | 7 1/2          | 7.5   | 6.5   | 9.5   | 8.6   | 12.2  | 9.5   | 10.7  | 8.0   | 9.2   | 8.5   | 8.0   | 9.5   |
|   | 10             | 9.0   | 8.5   | 12.5  | 11.4  | 16.3  | 12.6  | 14.3  | 10.5  | 12.2  | 11.5  | 10.5  | 12.7  |
|   | 15             | 14.5  | 12.7  | 18.7  | 17.0  | 24.4  | 18.9  | 21.4  | 16.0  | 18.5  | 17.0  | 15.7  | 19.2  |
|   | 20             | 19.5  | 17.0  | 25.5  | 23.0  | 33.2  | 25.5  | 29.0  | 21.5  | 25.0  | 23.0  | 21.2  | 26.0  |
|   | 25             | 24.3  | 21.0  | 31.5  | 28.5  | 41.1  | 32.1  | 36.2  | 26.5  | 30.0  | 26.5  | 26.5  | 32.0  |
|   | 30             | 29.0  | 25.5  | 37.7  | 34.0  | 49.2  | 38.0  | 43.0  | 32.0  | 37.0  | 34.2  | 31.5  | 38.5  |
|   | 40             | 39.0  | 39.0  | 50.2  | 45.5  | 65.7  | 50.7  | 57.5  | 42.5  | 48.5  | 45.7  | 42.2  | 51.5  |
|   | 50             | 48.5  | 42.5  | 62.7  | 57.0  | 82.5  | 62.7  | 72.0  | 52.2  | 61.0  | 57.0  | 52.7  | 64.0  |
|   | 60             | 58.0  | 51.0  | 75.5  | 68.0  | 98.0  | 75.0  | 86.0  | 63.0  | 73.0  | 68.9  | 62.0  | 75.0  |
|   | 75             | 75.0  | 65.0  | 95.0  | 86.0  | 122.0 | 95.0  | 107.0 | 80.0  | 92.0  | 85.0  | 80.0  | 95.0  |
|   | 100            | 97.0  | 85.0  | 125.5 | 114.0 | 165.0 | 124.5 | 144.0 | 103.0 | 121.0 | 112.0 | 103.0 | 125.0 |
|   | 120            | 116.0 | 102.0 | 151.0 | 136.0 | 198.0 | 149.0 | 173.0 | 124.0 | 145.0 | 134.0 | 124.0 | 150.0 |
|   | 150            | 145.0 | 127.0 | 188.0 | 170.0 | 247.0 | 186.0 | 216.0 | 155.0 | 181.0 | 168.0 | 155.0 | 187.0 |

## 5 TO 75 TONS · GCKA MODELS



## 100 TO 150 TONS · GCKA MODELS

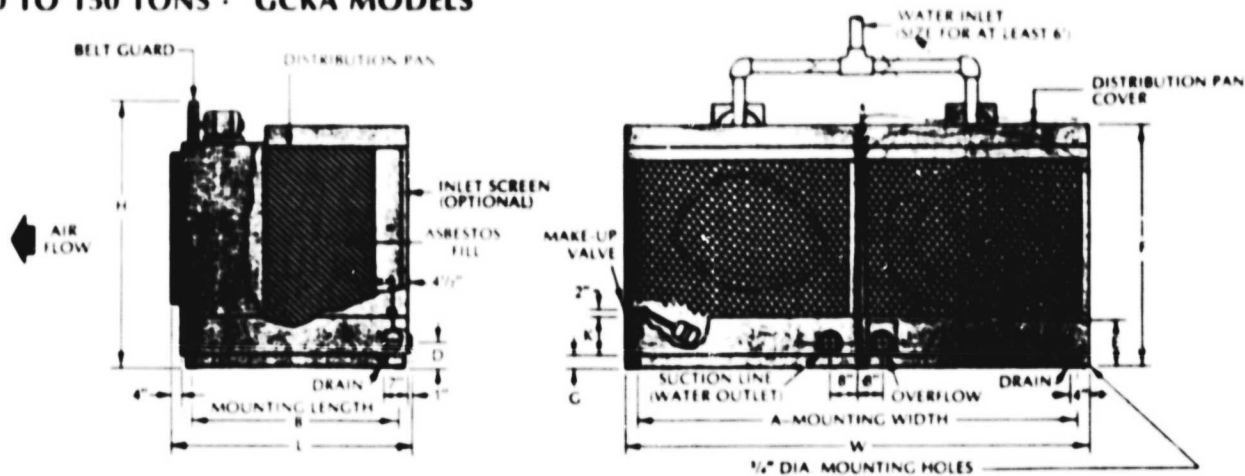


TABLE 2 · SPECIFICATIONS AND DIMENSIONS

| MODEL<br>NUMBER | CFM    | SUMP CAP GALS<br>TO OVERFLOW | MOTOR HP | LBS<br>ESTIMATED<br>WEIGHT |      | DIMENSIONS (INCHES) |    |        |     |    |       |       |        |       |     | REQUIRED<br>PIPE SIZES INCHES |                 |       |        | AIR INLET<br>INCHES |        | AIR OUTLET<br>INSIDE DIA.<br>INCHES |
|-----------------|--------|------------------------------|----------|----------------------------|------|---------------------|----|--------|-----|----|-------|-------|--------|-------|-----|-------------------------------|-----------------|-------|--------|---------------------|--------|-------------------------------------|
|                 |        |                              |          | SHIPPING                   | WET  | OVERALL             |    |        |     |    |       |       |        | IN    | OUT | OVERFLOW                      | WATER<br>MAKEUP | WIDTH | HEIGHT |                     |        |                                     |
|                 |        |                              |          |                            |      | W                   | L  | H      | A   | B  | D     | E     | F      |       |     |                               |                 |       |        | G                   | K      |                                     |
|                 |        |                              |          |                            |      |                     |    |        |     |    |       |       |        |       |     |                               |                 |       |        |                     |        |                                     |
| GCKA-5          | 1,500  | 25                           | 1/3      | 280                        | 488  | 29                  | 30 | 51 3/4 | 25  | 26 | 5 1/2 | 6 1/2 | 41 3/4 | 3 1/2 | 8   | 1 1/2                         | 1 1/2           | 1 1/2 | 1 1/2  | 26                  | 27 1/8 | 24 3/4                              |
| GCKA-7 1/2      | 2,250  | 35                           | 1/2      | 300                        | 592  | 29                  | 42 | 51 3/4 | 25  | 38 | 5 1/2 | 6 1/2 | 41 3/4 | 3 1/2 | 8   | 2                             | 2               | 1 1/2 | 1 1/2  | 26                  | 27 1/8 | 24 3/4                              |
| GCKA-10         | 3,000  | 35                           | 1/2      | 380                        | 672  | 29                  | 42 | 64 1/4 | 25  | 38 | 5 1/2 | 6 1/2 | 54 1/4 | 3 1/2 | 8   | 2                             | 2               | 1 1/2 | 1 1/2  | 26                  | 39 1/8 | 24 3/4                              |
| GCKA-15         | 4,500  | 45                           | 1/2      | 410                        | 785  | 36                  | 45 | 64 3/4 | 32  | 41 | 6     | 6 1/2 | 54 3/4 | 4     | 8   | 2                             | 2               | 1 1/2 | 1 1/2  | 33                  | 39 1/8 | 30 3/4                              |
| GCKA-20         | 6,000  | 101                          | 3/4      | 525                        | 1352 | 36                  | 54 | 81 1/2 | 32  | 50 | 6 1/2 | 12    | 77     | 4     | 14  | 2                             | 3               | 2     | 1 1/2  | 33                  | 52     | 30 3/4                              |
| GCKA-25         | 7,500  | 101                          | 1        | 545                        | 1372 | 36                  | 54 | 81 1/2 | 32  | 50 | 6 1/2 | 12    | 77     | 4     | 14  | 3                             | 3               | 2     | 1 1/2  | 33                  | 52     | 30 3/4                              |
| GCKA-30         | 9,000  | 101                          | 1 1/2    | 560                        | 1387 | 36                  | 54 | 81 1/2 | 32  | 50 | 6 1/2 | 12    | 77     | 4     | 14  | 3                             | 3               | 2     | 1 1/2  | 33                  | 52     | 30 3/4                              |
| GCKA-40         | 12,000 | 135                          | 2        | 720                        | 1845 | 48                  | 54 | 81 1/2 | 44  | 50 | 6 1/2 | 12    | 77     | 4     | 14  | 3                             | 3               | 2     | 1 1/2  | 45                  | 52     | 42 3/4                              |
| GCKA-50         | 15,000 | 168                          | 3        | 840                        | 2240 | 60                  | 54 | 81 1/2 | 56  | 50 | 6 1/2 | 12    | 77     | 4     | 14  | 4                             | 4               | 3     | 3/4    | 57                  | 52     | 48 3/4                              |
| GCKA-60         | 18,000 | 202                          | 5        | 1020                       | 1700 | 72                  | 54 | 81 1/2 | 68  | 50 | 6 1/2 | 12    | 77     | 4     | 14  | 4                             | 4               | 3     | 3/4    | 69                  | 52     | 48 3/4                              |
| GCKA-75         | 22,500 | 236                          | 5        | 1200                       | 3165 | 84                  | 54 | 81 1/2 | 80  | 42 | 8 1/8 | 12    | 77     | 4     | 14  | 4                             | 6               | 3     | 3/4    | 81                  | 52     | 48 3/4                              |
| GCKA-100        | 30,000 | 336                          | (2)<br>3 | 1740                       | 4540 | 120                 | 54 | 81 1/2 | 116 | 42 | 8 1/8 | 12    | 77     | 4     | 14  | 2@4                           | 6               | 3     | 3/4    | 117                 | 52     | 2x48 3/4                            |
| GCKA-120        | 36,000 | 404                          | (2)<br>5 | 2100                       | 5465 | 144                 | 54 | 81 1/2 | 140 | 42 | 8 1/8 | 12    | 77     | 4     | 14  | 2@4                           | 6               | 3     | 3/4    | 141                 | 52     | 2x48 3/4                            |
| GCKA-150        | 45,000 | 472                          | (2)<br>5 | 2460                       | 6390 | 168                 | 54 | 81 1/2 | 164 | 42 | 8 1/8 | 12    | 77     | 4     | 14  | 2@4                           | 6               | 3     | 3/4    | 165                 | 52     | 2x48 3/4                            |

Models GCKA 100-150 have twin fans and drives.

Models GCKA 50-150 have double groove pulleys and matched sets of belts.

All dimensions and specifications subject to change without notice. Consult H&M Sales Dept. for verified dimension drawings.

## H&M REMOTE TANKS

Halstead & Mitchell offers a complete line of sturdy, large capacity Remote Tanks for installation with H&M cooling towers. All tanks come complete with integral float valve for automatic control of tank water level.

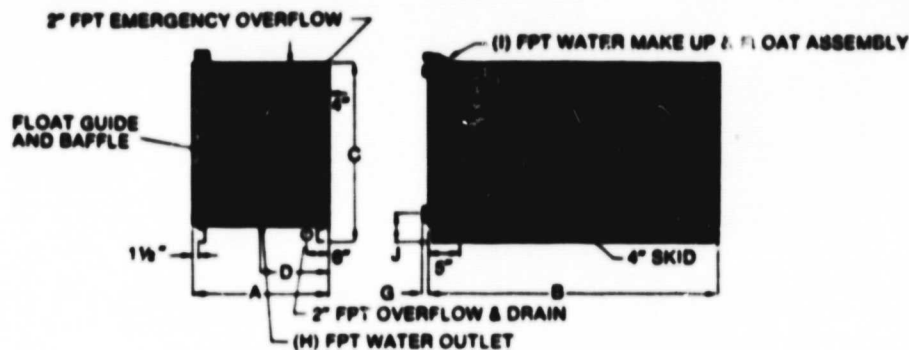


TABLE 3 • REMOTE TANKS

| COOLING TOWER MODEL NUMBER | REMOTE TANK MODEL NUMBER | CAPACITY GALLONS (F) | SHIPPING WEIGHT | DIMENSIONS (INCHES) |    |    |    |        |       |   |     |       |
|----------------------------|--------------------------|----------------------|-----------------|---------------------|----|----|----|--------|-------|---|-----|-------|
|                            |                          |                      |                 | OVERALL             |    |    | D  | E      | G     | H | I   | J     |
|                            |                          |                      |                 | A                   | B  | C  |    |        |       |   |     |       |
| GCKA 5                     | RT70                     | 70                   | 167             | 24                  | 30 | 28 | 12 | 23     | 1     | 2 | 1/2 | 6 1/2 |
| GCKA 7 1/2                 | RT70                     | 70                   | 167             | 24                  | 30 | 28 | 12 | 23     | 1     | 2 | 1/2 | 6 1/2 |
| GCKA 10                    | RT70                     | 70                   | 167             | 24                  | 30 | 28 | 12 | 23     | 1     | 2 | 1/2 | 6 1/2 |
| GCKA 15                    | RT100                    | 100                  | 190             | 24                  | 33 | 34 | 12 | 26 1/2 | 1 5/8 | 3 | 1/2 | 7 1/2 |
| GCKA 20                    | RT100                    | 100                  | 190             | 24                  | 33 | 34 | 12 | 26 1/2 | 1 5/8 | 3 | 1/2 | 7 1/2 |
| GCKA 25                    | RT200                    | 200                  | 290             | 30                  | 54 | 36 | 15 | 28 1/2 | 1 3/4 | 4 | 3/4 | 7 1/2 |
| GCKA 30                    | RT200                    | 200                  | 290             | 30                  | 54 | 36 | 15 | 28 1/2 | 1 3/4 | 4 | 3/4 | 7 1/2 |
| GCKA 40                    | RT300                    | 300                  | 450             | 30                  | 54 | 51 | 15 | 43     | 1 3/4 | 4 | 3/4 | 7 1/2 |
| GCKA 50                    | RT300                    | 300                  | 450             | 30                  | 54 | 51 | 15 | 43     | 1 3/4 | 4 | 3/4 | 7 1/2 |
| GCKA 60                    | RT300                    | 300                  | 450             | 30                  | 54 | 51 | 15 | 43     | 1 3/4 | 4 | 3/4 | 7 1/2 |
| GCKA 75                    | RT500                    | 500                  | 610             | 48                  | 70 | 42 | 24 | 34     | 1 3/4 | 4 | 3/4 | 7 1/2 |
| GCKA 100                   | RT500                    | 500                  | 610             | 48                  | 70 | 42 | 24 | 34     | 1 3/4 | 4 | 3/4 | 7 1/2 |
| GCKA 120                   | RT750                    | 750                  | 890             | 60                  | 60 | 56 | 30 | 48     | 2     | 6 | 3/4 | 8 3/8 |
| GCKA 150                   | RT1000                   | 1000                 | 1030            | 60                  | 72 | 64 | 30 | 53     | 2     | 6 | 3/4 | 8 3/8 |

TABLE 4 • CENTRIFUGAL PUMPS • MODELS H5 AND H9

When specifying a cooling tower, remember that H&M offers pumps for all cooling towers. Refer to H&M Bulletin HWP-101.

| COOLING<br>TOWER<br>MODEL<br>NUMBER | GPM<br>STD.<br>WATER<br>FLOW | PUMPING HEADS |                        |       |                        |       |                        |       |                        |       |                        |       |                        |        |                        |
|-------------------------------------|------------------------------|---------------|------------------------|-------|------------------------|-------|------------------------|-------|------------------------|-------|------------------------|-------|------------------------|--------|------------------------|
|                                     |                              | 15 ft         |                        | 30 ft |                        | 40 ft |                        | 50 ft |                        | 60 ft |                        | 75 ft |                        | 100 ft |                        |
|                                     |                              | HP            | H&M<br>MODEL<br>NUMBER | HP    | H&M<br>MODEL<br>NUMBER | HP    | H&M<br>MODEL<br>NUMBER | HP    | H&M<br>MODEL<br>NUMBER | HP    | H&M<br>MODEL<br>NUMBER | HP    | H&M<br>MODEL<br>NUMBER | HP     | H&M<br>MODEL<br>NUMBER |
| GCKA 5                              | 15                           | 1/2           | 1" -H5C2               | 1/2   | 1" -H5C2               | 1/2   | 1" -H5C2               | 1/2   | 1" -H5C2               | 3/4   | 3/4" -H5A2             | 1     | 3/4" -H5A2             | 1 1/2  | 3/4" -H5A2             |
| GCKA 7 1/2                          | 22.5                         | 1/2           | 1" -H5C2               | 1/2   | 1" -H5C2               | 1/2   | 1" -H5C2               | 1/2   | 1" -H5C2               | 3/4   | 3/4" -H5A2             | 1 1/4 | 3/4" -H5A2             | 1 1/2  | 3/4" -H5A2             |
| GCKA 10                             | 30                           | 1/2           | 1" -H5C2               | 1/2   | 1" -H5C2               | 1/2   | 1" -H5C2               | 1     | 3/4" -H5A2             | 1     | 3/4" -H5A2             | 1 1/4 | 3/4" -H5A2             | 3      | 1" -H9D2               |
| GCKA 15                             | 45                           | 1/2           | 1 1/2" -H5C2           | 1/2   | 1 1/2" -H5C2           | 3/4   | 1 1/2" -H5C2           | 1     | 1 1/2" -H5C2           | 1 1/2 | 3/4" -H5A2             | 2     | 1" -H5D2               | 5      | 1" -H9D2               |
| GCKA 20                             | 60                           | 1/2           | 1 1/2" -H5C2           | 1/2   | 1 1/2" -H5C2           | 1     | 1 1/2" -H5C2           | 1     | 1 1/2" -H5C2           | 2     | 1" -H5A2               | 3     | 1" -H9D2               | 5      | 1" -H9D2               |
| GCKA 25                             | 75                           | 1/2           | 1 1/2" -H5C2           | 3/4   | 1 1/2" -H5C2           | 1     | 1 1/2" -H5C2           | 1 1/2 | 1 1/4" -H5B2           | 2     | 1 1/4" -H5B2           | 5     | 1 1/4" -H9D2           | 5      | 1 1/4" -H9D2           |
| GCKA 30                             | 90                           | 1/2           | 1 1/2" -H5C2           | 1     | 1 1/2" -H5C2           | 1 1/2 | 1 1/4" -H5B2           | 1 1/2 | 1 1/4" -H5B2           | 3     | 1 1/4" -H9D2           | 5     | 1 1/4" -H9D2           | 5      | 1 1/4" -H9D2           |
| GCKA 40                             | 120                          | 1             | 1 1/2" -H5C2           | 1 1/2 | 1 1/2" -H5B2           | 2     | 1 1/2" -H9B2           | 3     | 1 1/4" -H9D2           | 5     | 1 1/4" -H9D2           | 5     | 1 1/4" -H9D2           | 5      | 1 1/4" -H9D2           |
| GCKA 50                             | 150                          | 2             | 2 1/2" -H9E2           | 3     | 2 1/2" -H9E2           | 3     | 2 1/2" -H9E2           | 5     | 2" -H9D2               | 5     | 2" -H9D2               | 7 1/2 | 2" -H9D2               | 7 1/2  | 2" -H9D2               |
| GCKA 60                             | 180                          | 2             | 2 1/2" -H9E2           | 3     | 2 1/2" -H9E2           | 5     | 2" -H9D2               | 5     | 2" -H9D2               | 5     | 2" -H9D2               | 7 1/2 | 2" -H9D2               | 7 1/2  | 2" -H9D2               |
| GCKA 75                             | 240                          | 2             | 2 1/2" -H9E2           | 3     | 2 1/2" -H9E2           | 5     | 2 1/2" -H9D2           | 5     | 2 1/2" -H9D2           | 7 1/2 | 2 1/2" -H9D2           | 7 1/2 | 2 1/2" -H9D2           | 10     | 2" -H9D2               |
| GCKA 100                            | 300                          | 3             | 2 1/2" -H9E2           | 5     | 2 1/2" -H9D2           | 5     | 2 1/2" -H9D2           | 7 1/2 | 2 1/2" -H9D2           | 7 1/2 | 2 1/2" -H9D2           | 7 1/2 | 2 1/2" -H9D2           | 10     | 2 1/2" -H9D2           |
| GCKA 120                            | 360                          | 5             | 2 1/2" -H9D2           | 7 1/2 | 2 1/2" -H9D2           | 7 1/2 | 2 1/2" -H9D2           | 7 1/2 | 2 1/2" -H9D2           | 7 1/2 | 2 1/2" -H9D2           | 10    | 2 1/2" -H9D2           | 15     | 2" -H9D2               |
| GCKA 150                            | 450                          | —             | —                      | —     | —                      | —     | —                      | —     | —                      | 10    | 2 1/2" -H9D2           | 10    | 2 1/2" -H9D1           | 15     | 2 1/2" -H9D2           |

For more information, write or call Halstead & Mitchell, A Division of Halstead Industries Inc., Scottsboro, Ala. 35768. (205) 259-1212.

**Halstead & Mitchell**  
A DIVISION OF HALSTEAD INDUSTRIES INC.

ORIGINAL PAGE IS  
OF POOR QUALITY



COOLING TOWER PUMP

**ATTENTION: READ THIS PUBLICATION CAREFULLY BEFORE ATTEMPTING TO INSTALL, OPERATE OR SERVICE THE TEEL CENTRIFUGAL PUMP. RETAIN FOR FUTURE REFERENCE!**

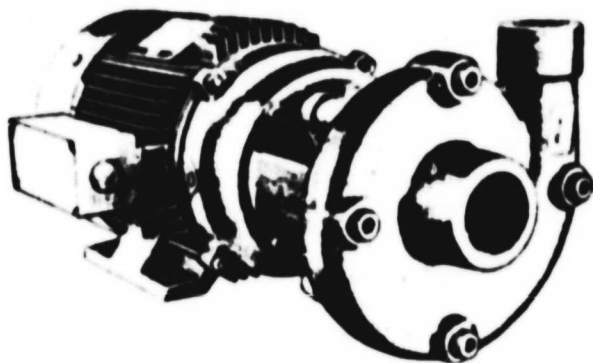


Figure 1 — Models 3P604, 3P606 and 3P608

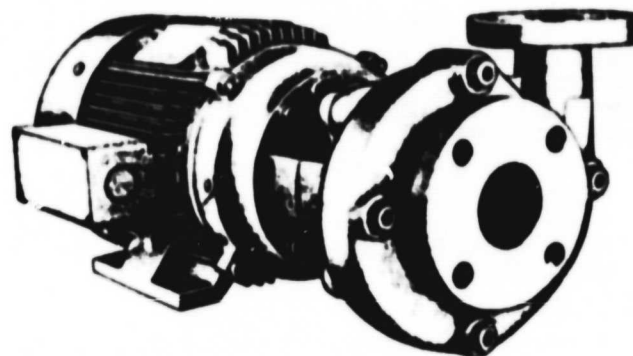


Figure 2 — Models 3P605 and 3P607

### Description

The Teel centrifugal pump is a non-self priming unit designed to handle liquid transfer and heating and cooling applications. The unit is equipped with a cast iron pump casing designed with full dual volute, clog resistant semi-open bronze impeller and a totally enclosed fan cooled electric motor. A mechanical seal isolates the motor from the liquid in the pump casing. The discharge port on the pump casing can be adjusted in 90° increments to accommodate the specific application.

Models 3P604, 3P606 and 3P608 are equipped with a pump casing to accommodate threaded suction and discharge piping connections. The pump casing used with Models 3P605 and 3P607 accommodates flange type suction and discharge piping connections.

**WARNING:** Do not use to pump flammable or explosive fluids such as gasoline, fuel oil, kerosene, etc. Do not use in explosive atmospheres. Failure to follow this warning can result in property damage and/or personal injury.

### Specifications

|                           |                               |
|---------------------------|-------------------------------|
| Threaded suction inlet    | 2" NPT                        |
| Flanged suction inlet     | 2"                            |
| Threaded discharge outlet | 1½" NPT                       |
| Flanged discharge outlet  | 1½"                           |
| RPM                       | 3600                          |
| Power supply              | 230/460 volts, 60 Hz, 3 phase |

### Specification and Performance Chart

| Model | wt<br>(lbs) | HP | Pump<br>Casing<br>Type | Dimensions |      |      | Gallons Per Minute at Pump Head in Feet |     |     |     |     |     |     |     |     |      |      |
|-------|-------------|----|------------------------|------------|------|------|---|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
|       |             |    |                        | H          | W    | L    | 10'                                     | 20' | 30' | 40' | 50' | 60' | 70' | 80' | 90' | 100' | 110' |
| 3P604 | 115         | 2  | Threaded               | 8¼"        | 10½" | 18¾" | 170                                     | 150 | 130 | 100 | 65  | 25  | —   | —   | —   | —    | —    |
| 3P605 | 151         | 3  | Flanged                | 9¼"        | 13¼" | 20¾" | —                                       | —   | 165 | 145 | 125 | 95  | 60  | 15  | —   | —    | —    |
| 3P606 | 173         | 3  | Threaded               | 9¼"        | 12"  | 20¾" | —                                       | —   | 165 | 145 | 125 | 95  | 60  | 15  | —   | —    | —    |
| 3P607 | 166         | 5  | Flanged                | 9¼"        | 13¼" | 22"  | —                                       | —   | —   | —   | 200 | 185 | 165 | 145 | 120 | 90   | 50   |
| 3P608 | 180         | 5  | Threaded               | 9¼"        | 12"  | 22"  | —                                       | —   | —   | —   | 200 | 185 | 165 | 145 | 120 | 90   | 50   |

**Operation (Continued)**

**WARNING:** Do not run pump dry as permanent damage to the mechanical seal will result.

4. Activate the unit.

**IMPORTANT:** Power should be applied momentarily to the pump at first and the direction of rotation checked. When viewing the rear of the motor (opposite the pump end), the motor shaft should be rotating clockwise. If it is not, disconnect power and re-check wiring to motor. (See "Installation" section.)

**NOTE:** Never shut-off discharge or restrict suction flow while the pump is operating.

**Maintenance**

**CAUTION:** MAKE CERTAIN THAT THE UNIT IS DISCONNECTED FROM THE POWER SOURCE BEFORE ATTEMPTING TO SERVICE OR REMOVE ANY COMPONENT!

1. If the pump is located in an area subject to freezing temperatures, the pump should be drained when not in operation. Also, the pump should be flushed after each use, if used with gummy or similar fluids.

2. to drain:

- a. Remove drain plug directly below suction line of the pump.
- b. Remove another drain plug to vent.

**NOTE:** The vent plug will be considered the uppermost drain plug on the pump casing.

- c. Drain suction pipe to a point below the frost line.
  - d. Drain all piping exposed to freezing temperatures.
3. All pumps are provided with shielded, prelubricated, ball bearings in the motor. Normally, re-lubrication of the bearings is not required.
  4. The pump casing should be removed and inspected periodically to insure that any foreign material or rust are not clogging internal pump parts.

**NOTE:** This unit is equipped with a dual volute pump casing. One of the volutes runs 1" all the way from the side opposite the discharge into the discharge through a completely enclosed passageway. If foreign material clogs this area, it can be dislodged by using a wire or long spring.

**Removal of Old Seal:**

Should the mechanical seal, which consists of seal seat (Ref. No. 7) and seal cartridge (Ref. No. 9), require replacement, proceed as follows and refer to Figure 3

**IMPORTANT:** Always replace BOTH the seal seat and the seal cartridge to insure proper mating of components!

1. Remove the four bolts (Ref. No. 4) that connects the casing cover (Ref. No. 5) to the casing (Ref. No. 14).
2. Remove the casing.

**CAUTION:** Care should be taken not to "pinch" or "shave" the casing gasket (Ref. No. 6) and the "O" ring between the casing cover and the casing.

3. Using an Allen wrench remove the impeller lock bolt (Ref. No. 13), the lead seal washer (Ref. No. 12), and the impeller (Ref. No. 11).

**IMPORTANT:** Care should be taken to insure that the same number of shim washers (Ref. No. 10) are replaced behind the impeller as were removed. These shim washers are located directly behind impeller. These washers as well as the impeller key (Ref. No. 2) become loose as the impeller is removed.

4. The seal cartridge (Ref. No. 9) and shaft sleeve (Ref. No. 8) can now be pulled from the shaft.
5. Pry the seal seat (Ref. No. 7) from the casing cover (Ref. No. 5).
6. Push the seal head (Ref. No. 9) from the shaft sleeve (Ref. No. 8).

**Installation of New Seal:**

**CAUTION:** The precision lapped faces on the mechanical seal are easily damaged. Handle your replacement seal carefully.

1. Clean the polished surface of the floating seat with a clean rag.
2. Wet the outer edge of the synthetic rubber seat ring with a soap solution.
3. Press the seat into the cavity firmly and squarely with *finger pressure only*. If the seat will not locate properly, place a cardboard washer over the polished surface and use a piece of standard pipe for pressing purposes.
4. Dispose of the cardboard washer. Check again that the polished surface is free of dirt or foreign particles and has not been scratched or damaged.
5. Thoroughly clean the outside of the shaft sleeve.
6. Push the new seal bellows onto the shaft sleeve.
7. Inspect the shaft and the inside of the shaft sleeve. Be sure that they are clean.
8. Clean the face of the carbon washer on the sealing end of the bellows.
9. Slide the shaft sleeve with the bellows assembly mounted on it onto the shaft.
10. Replace the shim washers. (See "Shim Adjustment" section.)
11. Replace the impeller key (Ref. No. 2) and impeller (Ref. No. 11). Do not forget to replace the lead impeller seal washer (Ref. No. 12) when screwing the impeller lock bolt (Ref. No. 13) in place.
12. Reassemble the rest of the pump.

**Shim Adjustment:**

When installing a replacement impeller (Ref. No. 11) or motor (Ref. No. 1), it may be necessary to adjust the number of shims (Ref. No. 10) to insure proper running clearance between the impeller and the casing. Proceed as follows:

**NOTE:** A proper running clearance is less than 0.010"

1. For impeller replacement, add one (1) shim in addition to the one (1) removed originally.

**Maintenance (Continued)**

2. For motor replacement, add two (2) shims in addition to the shims removed during disassembly.
3. Reassemble the pump as described in Steps 11 and 12. (See "Installation of New Seal" section).

**IMPORTANT:** Insure that the casing is snugly in place and check the shaft to make sure it is turning freely (use the screwdriver slot in the motor to turn the shaft). If it turns freely, check to insure that the casing cover and casing are fitted "metal to metal"

where they meet on the outside. If they are not "metal to metal", tighten the fasteners (Ref. Nos. 4 and 16) and recheck the shaft for free turning. Tighten carefully, turning the shaft while tightening so that the motor bearings are not damaged in the event that too many shims were installed. If shaft seizes before fasteners are completely tight, disassemble the pump and remove one (1) shim and repeat reassembly.

**Trouble Shooting Chart**

| SYMPTOM                                    | POSSIBLE CAUSES  | CORRECTIVE ACTION   |
|--|--|---|
| No liquid delivered                        | <ol style="list-style-type: none"> <li>1. Pump not primed</li> <li>2. Speed too low</li> <li>3. Air leak in suction</li> <li>4. Discharge head too high</li> <li>5. Suction lift too high</li> <li>6. Impeller plugged</li> <li>7. Wrong direction of rotation</li> </ol>  | <ol style="list-style-type: none"> <li>1. Prime pump.</li> <li>2. Check voltage.</li> <li>3. Repair or replace.</li> <li>4. Lower the height.</li> <li>5. Lower the height.</li> <li>6. Clean out.</li> <li>7. Change direction.</li> </ol>                                 |
| Not enough liquid delivered.               | <ol style="list-style-type: none"> <li>1. Air leaks in suction.</li> <li>2. Speed too low</li> <li>3. Discharge head too high</li> <li>4. Suction lift too high.</li> <li>5. Impeller partially plugged.</li> <li>6. Not enough suction head for hot liquid.</li> <li>7. Impeller or casing damaged</li> <li>8. Suction not submerged enough.</li> </ol> | <ol style="list-style-type: none"> <li>1. Repair or replace.</li> <li>2. Check voltage.</li> <li>3. Lower the height.</li> <li>4. Lower the height.</li> <li>5. Clean out.</li> <li>6. Increase suction head.</li> <li>7. Replace.</li> <li>8. Submerge suction.</li> </ol> |
| Not enough pressure.                       | <ol style="list-style-type: none"> <li>1. Speed too low.</li> <li>2. Air or gas in liquid or leaks in suction.</li> <li>3. Impeller damaged or partially plugged.</li> <li>4. Pumped liquid has too much solid material mixed with it</li> </ol>   | <ol style="list-style-type: none"> <li>1. Check voltage.</li> <li>2. Repair or replace suction line.</li> <li>3. Clean or replace.</li> <li>4. Add strainer.</li> </ol>   |
| Pump works for a while then loses suction. | <ol style="list-style-type: none"> <li>1. Leaky suction line.</li> <li>2. Suction lift too high.</li> <li>3. End of suction line uncovered</li> <li>4. Air leaks in suction.</li> </ol>  | <ol style="list-style-type: none"> <li>1. Repair or replace.</li> <li>2. Lower the height.</li> <li>3. Submerge end of suction line.</li> <li>4. Repair or replace suction line.</li> </ol>   |
| Motor runs hot                             | <ol style="list-style-type: none"> <li>1. Liquid heavier and more viscous than water.</li> <li>2. Seal binding</li> <li>3. Rotor binding.</li> <li>4. Voltage and frequency lower than rating.</li> <li>5. Defects in motor.</li> </ol>  | <ol style="list-style-type: none"> <li>1. Consult factory.</li> <li>2. Replace.</li> <li>3. Repair or replace.</li> <li>4. Reconnect to rated voltage and frequency.</li> <li>5. Repair or replace.</li> </ol>  |
| Seal leaks                                 | <ol style="list-style-type: none"> <li>1. Corrosion due to character of liquid pumped.</li> <li>2. Excessive amounts of abrasive material in liquid causing an accumulation around the rotating assembly which results in faces opening up and allowing grit between them</li> </ol>   | <ol style="list-style-type: none"> <li>1. Consult factory.</li> <li>2. Consult factory.</li> </ol>  |

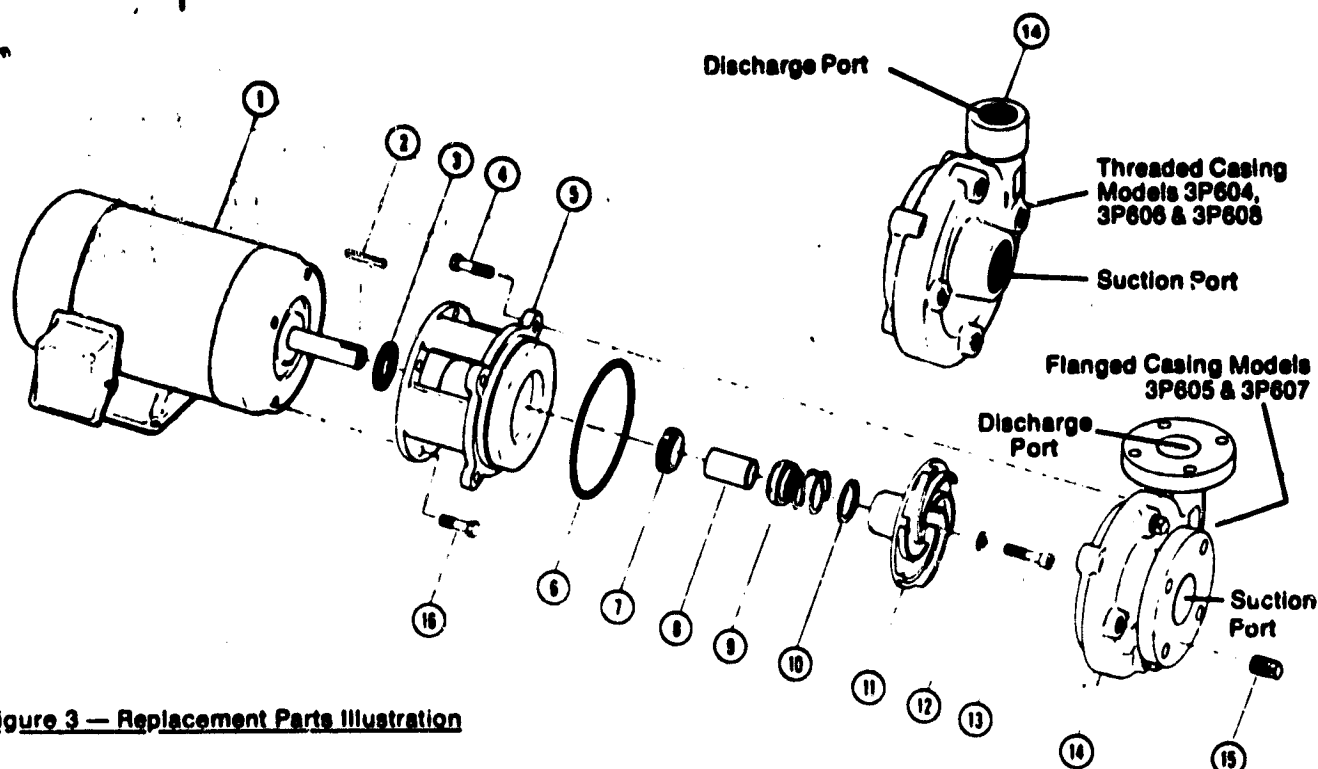


Figure 3 — Replacement Parts Illustration

## Replacement Parts List

| Ref. No. | Part No.   | Description  | Ref. No. | Part No.                              | Description   |
|----------|--|--|----------|---------------------------------------|---|
| 1        | { 9N058 or 9N084<br>9N059 or 9N085<br>9N060 or 9N086 | Motor 2 HP (Model 3P604)<br>Motor 3 HP (Models 3P605 and 3P606)<br>Motor 5 HP (Models 3P607 and 3P608) | 11       | { 1470.9901<br>1471.0002<br>1471.0001 | Impeller - 2 HP (Model 3P604)<br>Impeller - 3 HP (Models 3P605 and 3P606)<br>Impeller - 5 HP (Models 3P607 and 3P608) |
| 2        | 1471.30  | Impeller key   | 12       | 1471.20                               | Impeller seal washer  |
| 3        | 1470.93  | Flinger washer   | 13       | 1757.10                               | Impeller lock bolt, S.S. sock. hd. cap scr., 1/8-16 x 1 1/4   |
| 4        | .  | Hex hd. cap screw (4), 3/8-16 x 1 1/4  | 14       | { 1469.00<br>1470.00                  | Casing (flange, Models 3P605 and 3P607)<br>Casing (threaded, Models 3P604, 3P606 and 3P608)                           |
| 5        | 1470.01  | Casing cover   | 15       | .                                     | Drain plug (4) 1/2 NPT sock. hd.  |
| 6        | 1470.10  | Gasket   | 16       | .                                     | Hex hd. cap scr. (4), 3/8-16 x 1  |
| 7        | { 1654.00<br>1642.00                                 | Seal seat, Buna N<br>Seal seal, Viton (Optional)   |          |                                       |   |
| 8        | 1472.00  | Shaft sleeve   |          |                                       |   |
| 9        | { 1655.00<br>1645.00                                 | Seal cartridge, Buna A<br>Seal cartridge, Viton (Optional)   |          |                                       |   |
| 10       | 1656.00  | Impeller shims   |          |                                       |   |

\*Standard hardware items which can be purchased locally.

ORDER REPLACEMENT PARTS  
THROUGH DEALER FROM WHOM  
PRODUCT WAS PURCHASED

Please provide following information:

- Model Number
- Serial Number (if any)
- Part Description and Number as shown in Parts List.

If dealer cannot supply,  
order from:

Dayton Electric Mfg. Co.  
CUSTOMER SERVICE DEPT.  
5959 W. Howard St.  
Chicago, Illinois 60648

## LIMITED WARRANTY

Teel pumps, Models 3P604 thru 3P608, are warranted by Dayton Electric Mfg. Co. (Dayton) to the original user against defects in workmanship or materials under normal use (rental use excluded), for one year after date of purchase. Any part which is determined to be defective in material or workmanship and returned to an authorized service location, as Dayton designates, shipping costs prepaid, will be repaired or replaced at Dayton's option. For warranty claim procedures, see "Prompt Disposition" below. This warranty gives purchasers specific legal rights, and purchasers may also have other rights which vary from state to state.

WARRANTY DISCLAIMER Dayton has made a diligent effort to illustrate and describe the products in this literature accurately, however, such illustrations and descriptions are for the sole purpose of identification, and do not express or imply a warranty that the products are merchantable, or fit for a particular purpose, or that the products will necessarily conform to the illustrations or descriptions.

Except as provided below, no warranty or affirmation of fact, express or implied, other than as stated in "LIMITED WARRANTY" above is made or authorized by Dayton, and Dayton's liability in all events is limited to the purchase price paid.

Certain aspects of disclaimers are not applicable to consumer products; e.g., (a) some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you, (b) also, some states do not allow limitations on how long an implied warranty lasts, consequently the above limitation may not apply to you, and (c) by law, during the period of this Limited Warranty, any implied warranties of merchantability or fitness for a particular purpose applicable to consumer products purchased by consumers, may not be excluded or otherwise disclaimed.

PROMPT DISPOSITION Dayton will make a good faith effort for prompt correction or other adjustment with respect to any product which proves to be defective within warranty. For any product believed to be defective within warranty, first write or call dealer from whom product was purchased. Dealer will give additional directions if unable to resolve satisfactorily, write to Dayton at address below, giving dealer's name, address, date and number of dealer's invoice, and describing the nature of the defect. If product was damaged in transit to you, file claim with carrier.

DAYTON ELECTRIC MFG. CO., 5959 W. HOWARD ST.  
CHICAGO, ILLINOIS 60648



### General Safety Information

1. Follow all local electrical and safety codes, as well as the National Electrical Code (NEC) and the Occupational Safety and Health Act (OSHA).
2. Replace or repair damaged or worn cord immediately.
3. Protect the power cable from coming in contact with sharp objects.
4. Do not kink power cable and never allow the cable to come in contact with oil, grease, hot surfaces, or chemicals.
5. Make certain that the power source conforms to the requirements of your equipment.
6. Always disconnect power source before performing any work on or near the motor or its connected load. If the power disconnect point is out-of-sight, lock it in the open position and tag it to prevent unexpected application of power. Failure to do so could result in fatal electrical shock!
7. Do not handle the pump with wet hands or when standing in water as fatal electrical shock could occur. Disconnect main power before handling unit for **ANY REASON!**
8. Motor must be securely and adequately electrically grounded. This can be accomplished by wiring with a grounded, metal-clad raceway system, by using a separate ground wire connected to the bare metal of the motor frame, or other suitable means.

### Unpacking

When unpacking the unit, inspect carefully for any damage that may have occurred during transit. Check for loose parts, missing parts or damaged parts.

### Installation

1. Locate pump as close to the fluid source as possible, thus, making the suction line as short and direct as possible. **Unit is not self priming.**
2. The pump should be placed in an area where the ambient temperature will not exceed 40°C (104°F) and it is protected from extremes of cold, heat and humidity. Allow ample space for future maintenance and repair should it become necessary.
3. If necessary, adjust discharge port on the casing (Ref. No. 14) as follows using Figure 3 for reference:
  - a. Unthread four fasteners (Ref. No. 4) from casing cover (Ref. No. 5) and gently remove casing (Ref. No. 14) from the casing cover.
  - b. Rotate casing so that the discharge port is in the position desired.  
NOTE: Pump performance will not be affected by the position of the discharge port.
  - c. Reassemble the casing to the casing cover by threading the four fasteners into the casing cover and casing.  
**CAUTION: Do not overtighten the four fasteners which secure casing to the casing cover.**
4. Mount unit on a solid foundation and secure with appropriate fasteners.

5. Attach piping suction line to suction inlet and piping discharge line to discharge outlet. Avoid using looped sections of pipe or fittings which might permit air to become trapped. Use pipe dope to insure air tight pipe connections.

**IMPORTANT:** If plastic or fabric hose is used for the suction piping, it should be of a reinforced type so as not to collapse under suction. The suction piping should be one size larger than the discharge piping.

6. Support the piping independently of the pump to avoid universal or excessive stresses on the pump casing which would cause impeller misalignment and possible pump failure.
7. Install both a union and a gate valve (not furnished) on the discharge side of the pump for service convenience.

**CAUTION:** Do not use a globe or other restricting type of valve at the discharge. Globe valves seriously restrict the capacity of the pump.

8. It is mandatory that a foot valve be used on the suction line to assure quick priming and that a suitable suction strainer be attached to the suction line so that large pieces of foreign material are not drawn into the pump.

**IMPORTANT:** The foot valve must be located below the free level of the liquid in suction.

9. Wiring:
  - a. Follow all local electrical and safety codes, as well as the National Electrical Code (NEC) and the Occupational Safety and Health Act (OSHA).
  - b. Motor must be securely and adequately grounded. This can be accomplished by wiring with a grounded, metal-clad raceway system, by using a separate ground wire connected to the bare metal of the motor frame, or other suitable means.
  - c. Connections should be made with flexible conduit to minimize vibration transmission.
  - d. Use wire of adequate size to minimize voltage drop at the motor. **DOUBLE CHECK ALL CONNECTIONS.** (Refer to wiring diagram on motor nameplate.)

**WARNING: MOTOR IS DESIGNED FOR 60 Hz., 3 PHASE POWER ONLY!**

10. Inspect impeller for proper rotation. When viewing the rear of the motor (opposite the pump end), the motor shaft should rotate clockwise.

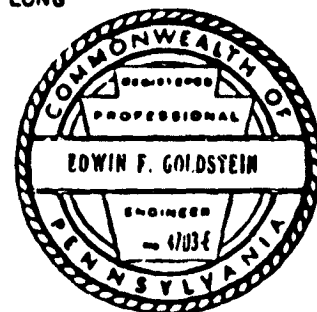
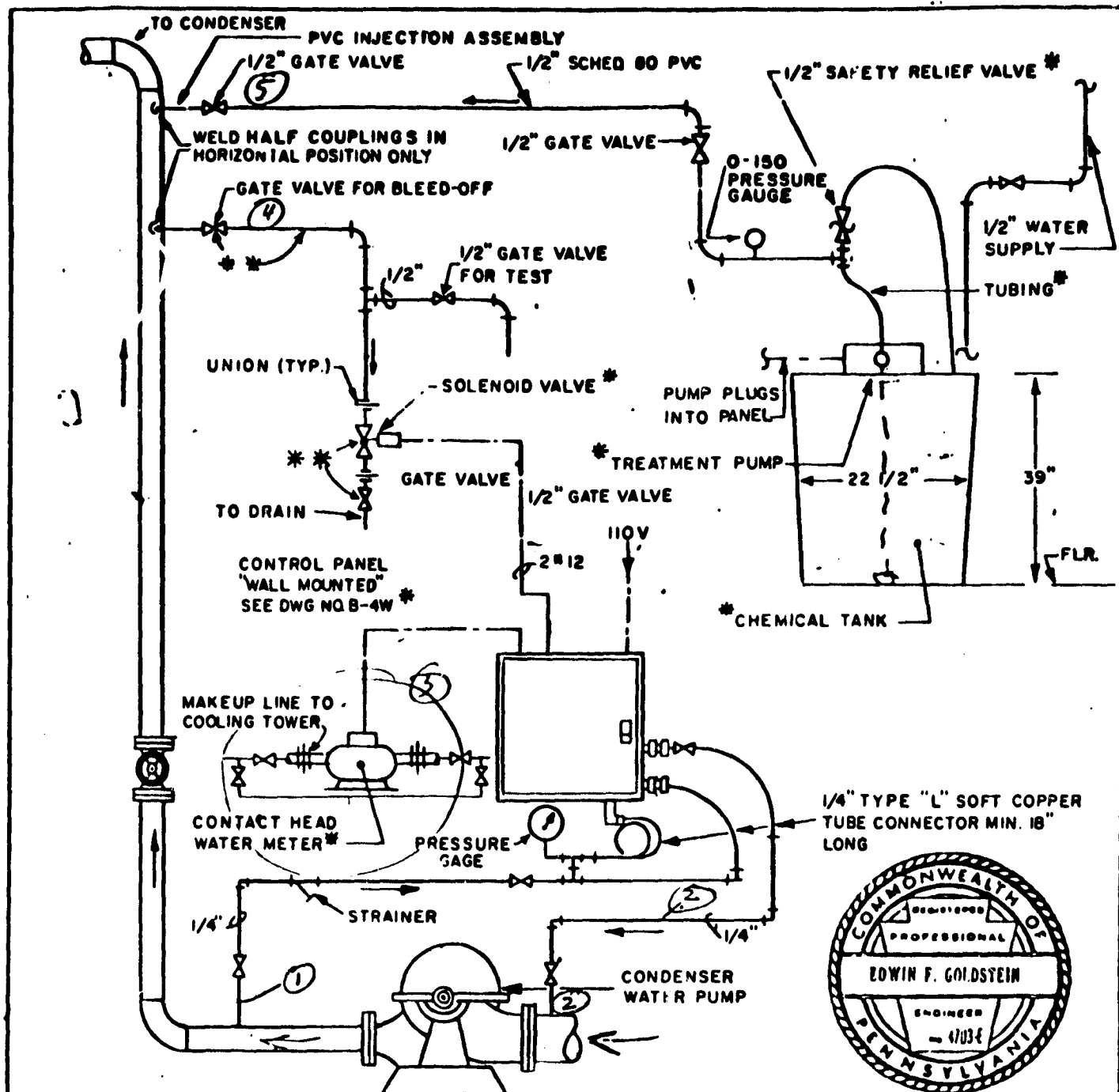
**IMPORTANT:** Proper impeller rotation direction is critical for centrifugal pumps. The interchanging of any two wires will change rotation direction.

11. Install auxiliary components (e.g. — pressure switch, timer, etc.).

### Operation

1. The casing and suction piping must be filled with liquid before the unit can begin pumping.
2. In order to completely fill casing with liquid, entrapped air in casing must be vented. This is accomplished by removing the top drain plug located on the casing.
3. Prime the pump by filling the casing with liquid through the top drain plug.

COOLING TOWER  
TREATMENT SYSTEM



7/3/80

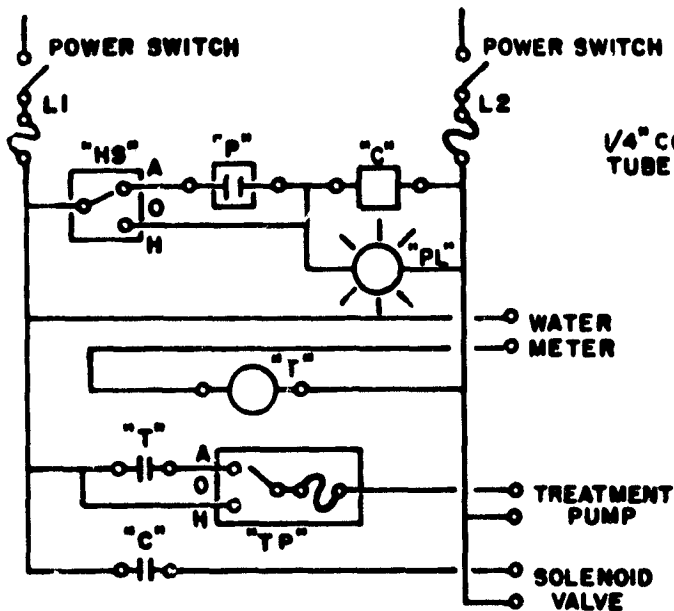
\* EQUIPMENT FURNISHED BY ARC CO.  
 \* COOLING TOWER CAPACITY - TONS  
 1/2" UP TO 300, 3/4" 300 TO 1000,  
 1" OVER 1000

DRAWING B-4-A

ARC COMPANY INC.

114 HARVEY ST. PHILADELPHIA, PA. 19144

COOLING TOWER CHEMICAL  
 FEED SYSTEM  
 FULLY AUTOMATED



## COOLING TOWER BLEED-OFF AND CHEMICAL FEED CONTROL PANEL

FLOW METERS





## E83 LIQUID VORTEX FLOWMETER

The E83 Series Vortex Flowmeter has the advantages of wide rangeability, high accuracy and low installation cost to make it an excellent choice for a wide variety of liquid flow measurement applications.

### INTRODUCTION

The E83 Series Vortex Flowmeter, as shown above, measures liquid flow rates using the principle of vortex shedding. The transmitter produces either an electronic analog or pulse rate signal linearly proportional to volumetric flow rate.

Liquid flowing through the meter housing passes a specially-shaped vortex element which causes vortices to form and shed (separate) from alternate sides of the element at a rate proportional to the flow rate of the liquid. These shedding vortices create an alternating differential pressure which is sensed by a detector located in the "tail" of the vortex generator. An ac voltage signal is produced in the flowmeter with a frequency synchronous with the vortex shedding frequency.

### CONTENTS . . .

Introduction

Principle of Operation

Instrument Description

Vortex Flowmeter Characteristics

Cavitation

Pressure Loss

**FOXBORO**

RELIEF VALVES

- A. Berm - 2" x 2" #174A
- B. Boiler - 1½" x 1½" #174A
- C. Sub-Arrays - ½" #5300A

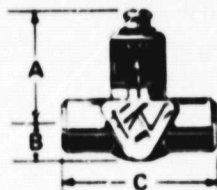
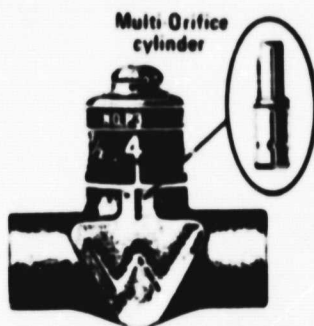
# WATTS

## No. P3

**Multi-Orifice Flow Controls for Tankless Heaters**  
Adjusts to 2½, 3, 3½ or 4 GPM  
Max. Temperature 250°F.  
Max. Pressure 150 psi.

Watts Flow Control valves are designed to limit the flow of water to equipment and are ideally used for tankless heater installations. Features a multi-orifice design which lets you select desired flows at 50 psi (as shown above) simply and quickly by turning the cap to the required setting. Setting is obtained by locating multi-orifice cylinder adjusting cap to the marking over the matching line on the body.

For other pressures and flow capacities see instruction sheet.



| No. | Size | Dimensions |    |    | Wgt. (oz.) |
|-----|------|------------|----|----|------------|
|     |      | A          | B  | C  |            |
| P3  | ½"   | 1 5/8"     | ½" | 2" | 6          |

## No. TC (Replaces former No. P2)

**Multi-purpose "Ball" Type Valve**  
For Use as Test Cock,  
Balancing, Shut-off or Drain.

No. TC is an efficient, dependable, positive, "ball" type shut-off valve for liquids. It has a brass ball that rotates smoothly against a "Teflon" seat for positive open or closed position. The ball cleans and lubricates itself as it is rotated—no sticking. Flow can be controlled by partial rotation of the ball. A female screwed outlet connection provides easy attachment of test hoses, etc.



| No.  | Size N.P.T. | DIMENSIONS |      |      | Wgt. (oz.) |
|------|-------------|------------|------|------|------------|
|      |             | A          | B    | C    |            |
| TC-1 | ⅛"          | 1 3/4"     | ½"   | 7/8" | 3 1/2      |
| TC-2 | ¼"          | 1 3/4"     | ½"   | 7/8" | 3 1/2      |
| TC-4 | ½"          | 1 7/8"     | ½"   | 7/8" | 4          |
| TC-6 | ¾"          | 2"         | 5/8" | 7/8" | 5          |

## No. 600 Series

**"Maxi-Flo" Check Valve**

The No. 600 is designed to allow full fluid flow. A highly machined brass disc with a "Teflon" seat assures tightest possible seating capacity. Stainless steel guide rod and spring for added strength and protection against corrosives. The valve can be installed horizontally or vertically. Easily replaceable seat and check assembly. Rated at 125 lbs. steam and 400 lbs. WOG.



| No. | Size         | Height | Length | Wgt. (lbs.) |
|-----|--------------|--------|--------|-------------|
| 600 | ¼", 3/8", ½" | 2 1/8" | 1 1/4" | 1/2         |
| 600 | ¾"           | 2 1/2" | 1 1/2" | 3/4         |
| 600 | 1"           | 3 1/8" | 2"     | 1 3/8       |
| 600 | 1 1/4"       | 3 3/4" | 2 1/2" | 2 1/8       |
| 600 | 1 1/2"       | 4"     | 2 3/4" | 3           |
| 600 | 2"           | 4 1/2" | 3 1/2" | 4 3/8       |

## No. BP30 Series

**Diaphragm Operated Relief Valve**

**By-Pass Control Valves**

Diaphragm actuated by pass relief valves to regulate liquid pressure as supplied by a positive pressure pump. Protects equipment by opening at desired setting and allowing excess volume to be by-passed back to source. Construction is bronze body. Sensitive rubber diaphragm and special Teflon disc. Furnished with T handle to facilitate pressure change. Spring and adjustment handle free from contact with liquid elements being controlled.

Max. Temperature 180°F. Size: ½".



No. BP30

### PRESSURE RANGES

| Series BP30 | Ordering Code |
|-------------|---------------|
| 10-50       | BP30A         |
| 45-100      | BP30B         |
| 75-175      | BP30C         |

| No.  | Size | Height | Length | Weight     |
|------|------|--------|--------|------------|
| BP30 | ½"   | 5 3/4" | 2 1/4" | 1 1/8 lbs. |

## No. 5300A

**Poppet Type Relief Valve**

**For By-Pass Service**

Compact, low cost, poppet type by pass valve for low capacity requirements. All bronze construction, stainless steel spring and Teflon disc. Stuffing box seals against leakage around adjustment "T" handle.

Pressure range: 35-175 lbs.

Size: ½"

Max. Temperature 180°F.

Max. Pressure 175 psi.



No. 5300A

| No.   | Size | Height | Length | Weight |
|-------|------|--------|--------|--------|
| 5300A | ½"   | 4 1/2" | 1 1/8" | 3/4 lb |

### FEATURES

- Low pressure drop equivalent to swing checks.
- Install in horizontal or vertical position.
- "Teflon" seat for tight positive seating.

## No. 174A Series

### A.S.M.E. Water Pressure Relief Valves

Bronze body relief valves for pressure protection only of all types of hot water heating boiler equipment. Pressure range 30 lbs. to 160 lbs. with corresponding high BTU/HR ratings from 650,000 to 14,370,000 BTU/HR. Female inlet and outlet connections. Sizes  $\frac{1}{4}$ " to 2" inclusive.

- Seat located above drain - water can't be trapped and sediment can't foul seat
- Non mechanical seat to disc alignment will not stick or freeze
- Water seal of high temperature resisting material isolates spring working parts from water during relief

**NOTE:** For recommended Temperature and Pressure Protection of Domestic Hot Water Supply Systems, see page 14

| No.  | Size                                  | Model | Height             | Length            | Weight                |
|------|---------------------------------------|-------|--------------------|-------------------|-----------------------|
| 174A | $\frac{3}{4}$ " x $\frac{3}{4}$ "     | M3    | 5 $\frac{1}{8}$ "  | 2 $\frac{1}{2}$ " | 1 $\frac{1}{2}$ lbs.  |
| 174A | 1" x 1"                               | M1    | 5 $\frac{3}{4}$ "  | 3"                | 3 $\frac{1}{8}$ lbs.  |
| 174A | 1 $\frac{1}{4}$ " x 1 $\frac{1}{4}$ " | M1    | 8 $\frac{3}{8}$ "  | 4 $\frac{3}{4}$ " | 6 $\frac{1}{4}$ lbs.  |
| 174A | 1 $\frac{1}{2}$ " x 1 $\frac{1}{2}$ " | M     | 9"                 | 4 $\frac{7}{8}$ " | 7 $\frac{1}{4}$ lbs.  |
| 174A | 2" x 2"                               | M     | 11 $\frac{5}{8}$ " | 6 $\frac{1}{4}$ " | 13 $\frac{3}{4}$ lbs. |

### SETTINGS and RELIEVING CAPACITIES (National Board Certified Ratings) BTU Steam Discharge Capacities

| Size              | 30 lbs.   | 100 lbs.  | 125 lbs.   | 150 lbs.   |
|-------------------|-----------|-----------|------------|------------|
| $\frac{1}{4}$ "   | 650,000   | 1,695,000 | 2,070,000  | 2,445,000  |
| 1"                | 1,005,000 | 2,635,000 | 3,215,000  | 3,795,000  |
| 1 $\frac{1}{4}$ " | 1,682,000 | 4,399,000 | 5,370,000  | 6,340,000  |
| 1 $\frac{1}{2}$ " | 2,020,000 | 5,290,000 | 6,460,000  | 7,630,000  |
| 2"                | 3,815,000 | 9,970,000 | 12,170,000 | 14,370,000 |

**NOTE:** We recommend No. 740 Series as best buy for hot water space heating boiler requirements between 30 through 75 lbs.

No. 174A and 740 are for protection against excessive water pressure caused by thermal expansion of the water. However, the valve also has an emergency BTU steam discharge capacity if run-away firing conditions occur, but do not use for steam service installations.

The function of the valve is to prevent excessive pressures above the valve setting, but valve will not prevent the natural build-up of temperature in the boiler because the valve works on pressure only and temperature does not affect its operation. Therefore, for domestic hot water supply systems, to prevent excessive temperature above 212°, which might result in overheating explosive dangers, combined temperature and pressure relief protection is essential.

Watts self closing combination temperature and pressure relief valves give this protection as described on page 14.



# WATTS RELIEF VALVES A.S.M.E. BOILER PRESSURE

## No. 740 Series

### A.S.M.E. Boiler Safety Water Relief Valves

Iron body relief valves with expanded outlets for hot water space heating boilers. Pressure range 30 lbs. to 75 lbs. with corresponding high ratings from 925,000 to 10,700,000 BTU/HR. This wide range of relieving capacities provides a much lower BTU per thousand cost because this series provides a much higher BTU rating, size for size, than other valves on the market. Female inlet and outlet connections. Sizes  $\frac{1}{4}$ " to 2" inclusive.

- Same design features as No. 174A except for difference in body construction and material

| No. | Size                                  | Model | Height             | Length            | Weight                |
|-----|---------------------------------------|-------|--------------------|-------------------|-----------------------|
| 740 | $\frac{3}{4}$ " x 1"                  | M1    | 5 $\frac{5}{8}$ "  | 3"                | 1 $\frac{7}{8}$ lbs.  |
| 740 | 1" x 1 $\frac{1}{4}$ "                | M     | 7 $\frac{1}{4}$ "  | 3 $\frac{1}{2}$ " | 3 $\frac{1}{8}$ lbs.  |
| 740 | 1 $\frac{1}{4}$ " x 1 $\frac{1}{2}$ " | M     | 8 $\frac{3}{4}$ "  | 4 $\frac{5}{8}$ " | 6 $\frac{1}{8}$ lbs.  |
| 740 | 1 $\frac{1}{2}$ " x 2"                | M     | 9 $\frac{1}{4}$ "  | 5 $\frac{1}{4}$ " | 7 $\frac{1}{2}$ lbs.  |
| 740 | 2" x 2 $\frac{1}{2}$ "                | M     | 11 $\frac{5}{8}$ " | 6 $\frac{3}{4}$ " | 16 $\frac{1}{2}$ lbs. |

### SETTINGS and RELIEVING CAPACITIES (National Board Certified Ratings) BTU Steam Discharge Capacities

| Size                                  | 30 lbs.   | 45 lbs.   | 50 lbs.   | 75 lbs.    |
|---------------------------------------|-----------|-----------|-----------|------------|
| $\frac{1}{4}$ " x 1"                  | 925,000   | 1,245,000 | 1,352,000 | 1,886,000  |
| 1" x 1 $\frac{1}{4}$ "                | 1,300,000 | 1,749,000 | 1,899,000 | 2,649,000  |
| 1 $\frac{1}{4}$ " x 1 $\frac{1}{2}$ " | 2,105,000 | 2,830,000 | 3,075,000 | 4,285,000  |
| 1 $\frac{1}{2}$ " x 2"                | 2,900,000 | 3,903,000 | 4,238,000 | 5,910,000  |
| 2" x 2 $\frac{1}{2}$ "                | 5,250,000 | 7,050,000 | 7,650,000 | 10,700,000 |

**NOTE:** Valve settings, other than shown above, are available in 5 lb. increments between the pressure range of 30 through 75 lbs.

## Nos. 315, 415

ASME Tested and Rated

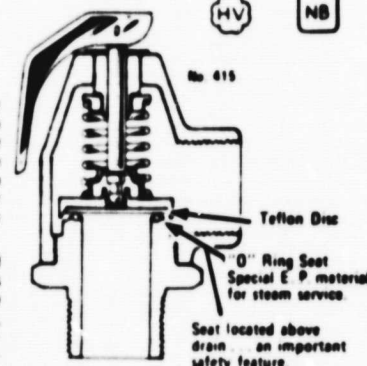
### Steam Safety Valves

#### For Steam Service Installations

Watts No. 415 ASME rated Steam Safety Relief Valves up to 450 lbs./hr. have been developed to provide high quality dependable low cost protection for any low pressure steam heating equipment up to 15 lbs. They are also available with lower settings, such as 8 lbs. for pressure cooker requirements. Consult factory for rating and quotation.

These valves are designed with the seat elevated above the I.D. of a connected drain. This eliminates the need of "a body drain below seat level - in the valve or in the outlet piping" as required in ASME Section IV Article HG 401.1 Para. (h) providing, of course, a connected drain pipe is pitched down from the valve outlet.

This feature protects against potential injury from steam discharge and complies with the requirements of the Consumer Product Safety Act.



### A.S.M.E. Steam Discharge Capacity

| No. | Size                              | Lbs./Hr. (Set 15 lbs.) | Dimensions                              | Weight              |
|-----|-----------------------------------|------------------------|---|---------------------|
| 315 | $\frac{3}{4}$ " x $\frac{3}{4}$ " | 300                    | 1 $\frac{3}{4}$ " x 1 $\frac{13}{16}$ " | 5 $\frac{1}{8}$ lb. |
| 415 | $\frac{3}{4}$ " x $\frac{3}{4}$ " | 450                    | 2 $\frac{1}{8}$ " x 1 $\frac{13}{16}$ " | 1 lb.               |

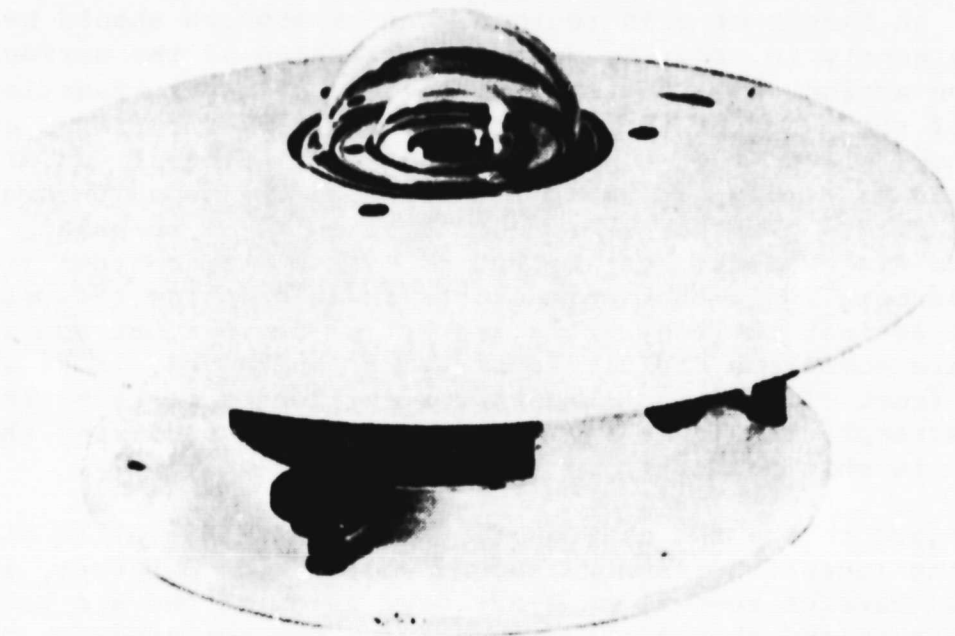
Insolation Detector

(Eppley Pyranometer)



# EPPLEY PRECISION PYRANOMETER

Model PSP



## INSTRUMENT CHARACTERISTICS

|                        |  |
|------------------------|--|
| Sensitivity            | 9 microvolts per watt meter <sup>-2</sup> approx.  |
| Impedance              | 650 ohms approx.   |
| Receiver               | circular 1 cm <sup>-2</sup> , coated with Parsons' black optical lacquer   |
| Temperature dependence | ±1 per cent over ambient temperature range -20 to +40°C (temperature compensation of sensitivity can be supplied over other ranges at additional charge)   |
| Linearity              | ±0.5 per cent from 0 to 2500 watts m <sup>-2</sup>   |
| Response time          | 1 second (i/e signal)  |
| Cosine                 | ±1 per cent from normalization 0 - 70° zenith angle  |
| Orientation            | ±3 per cent 70 - 80° zenith angle  |
| Mechanical vibration   | no effect on instrument performance  |
| Calibration            | tested up to 20g's without damage  |
|                        | integrating hemisphere (approx. 1 cal cm <sup>-2</sup> min <sup>-1</sup> , ambient temperature +25°C): calibration reference Eppley primary standard group of Angstrom pyrheliometers reproducing the International Pyrheliometric Scale |
| Readout                | potentiometric in preference to microammeter devices   |

Fig. 1

ORIGINAL PAGE IS  
OF POOR QUALITY



(c) Maintenance

Pyranometers and pyrgeometers in continuous operation should be inspected, ideally, at least once per day. At these inspections, the (outer) hemisphere should be wiped clean and dry with a lint-free soft cloth. In desert or arid regions, the hemisphere should be cleaned very gently in order to prevent scratching of the surface. Such abrasive action can alter appreciably the original transmission properties of the material and, hence, the radiometer calibration. If frozen snow, glazed ice, hoar frost or rime is present, an attempt should be made to remove, at least temporarily, the deposit carefully with warmed cloths. In the polar regions, it will be necessary to experiment to discover the best method of keeping radiometers frost free. It has been found that warm cloths (heated inside the recorder hut and held against the body while travelling between hut and instruments) are sometimes useful. Under some conditions, it is impossible to keep frost off the instruments for any length of time; in such instances, attempts should be made at convenient times during the day when the sun is shining.

With regard to the two models of pyranometer, should the internal surface of the (outer) hemisphere become coated with moisture, it can be cleaned by careful removal on a dry day, allowing the air to evaporate the moisture and then firmly re-securing the hemisphere. The inside of the hemisphere should not be wiped unless smears are visible. Precautions should be taken to avoid scratching the undersurface of the collar carrying this hemisphere. In the case of the precision spectral pyranometer, the external surface of the inner hemisphere can also be cleaned, if necessary, when the large one is removed. Should moisture be deposited on the inside of the small hemisphere, this can similarly be removed. However, in this instance, and also with removal of the single hemispherical envelope of the black and white model, extreme care must be exercised since the thermopile element is now unprotected and could be seriously damaged.

Occasionally, the desiccator installed in the pyranometer case should be inspected. Whenever the silica gel drying agent is pinkish or white in color, it should be replaced (N.B. silica gel can be rejuvenated by drying in an oven at about 135°C for a few hours, until the original dark blue color reappears).

The circular spirit level of the pyranometer or pyrgeometer should be inspected at regular intervals.

With regard to the pyrgometer, the same maintenance procedures are applicable. However, care should be exercised when cleaning the external surface of the hemisphere since the protective coating on the KRS-5 material is vacuum deposited and, therefore, thin and fragile. The hemisphere should only be removed when calibration verification indicates that the results are suspect; in this instance, the interference filter (vacuum) deposited on the internal surface of the hemisphere must never be touched.

Although the external surface of the KRS-5 hemisphere of the pyrgometer is treated to be impervious to weather effects, the coating may deteriorate in the course of time exposing the KRS-5 surface. In such an event, discoloration (in the extreme, a corrosive layer with rain in the presence of sea salt) may develop. However, this is more of a nuisance than a measurement problem, since tests, at Newport, have demonstrated that despite an obvious deterioration in the envelope transmission in the visible region, the infrared characteristics are not significantly affected. But, to avoid permanent damage to the hemisphere system, such impurities should be removed as soon as they are noticed. The recommended cleanser for uncoated KRS-5 is methyl ethyl ketone. In the case where such surface contamination cannot be so removed, the hemisphere can be reground, polished and coated by the Eppley Laboratory.

#### 6. Readout Instrumentation

Recommended types of recording and integrating devices are described in the manufacturers' literature (obtainable on request from the Eppley Laboratory). Electronic strip-chart, millivolt potentiometric recorders (incorporating variable-range rheostats) are available, to permit the exact matching of the recorder scale to any specific pyranometer or pyrgometer sensitivity and so yielding chart deflections expressed directly either in the  $\text{cal cm}^{-2} \text{min}^{-1}$  or the  $\text{mW cm}^{-2}$  unit. Built-in integrators with visually-read digital display and also auxiliary print-out equipment can be supplied with these recorders. Standard types of digital voltmeter are likewise suitable. With low irradiance values, particularly in the infrared, it is sometimes convenient to increase the read-out resolution of the records, by use of a pre-amplifier, to reproduce a pyrgometer calibration accuracy of  $\pm 3$  per cent or better. The readout instrumentation employed should be firmly mounted, either in a panel assembly or on an inside wall of the room where it is to be located. On account of the relatively high impedance of Eppley pyranometers and pyrgometers, they are not suitable for use with microammeters.

URETHANE FOAM

**Technical Information  
Bulletin****STEPANFOAM™ BX-350-7****RIGID URETHANE FOAM SYSTEM**

**DESCRIPTION:** The Stepanfoam BX-350-7 is designed as a spray system for use as thermal insulation in panels, cavities and roofing applications. This system has been designed to give a very smooth surface on horizontal and inclined roofing applications. The BX-350-7 foam can be applied to plywood, steel, concrete and other various substrates at temperatures of 60-100°F.

**PHYSICAL CHARACTERISTICS:** The Stepanfoam BX-350-7 is a low viscosity system specifically formulated to offer the maximum compatibility and ease of atomization necessary for spray applications. The reactivity of BX-350-7 at a hose temperature of 130-140°F. and a block temperature of 150-160°F. will give a tack free time (set time) of 7 seconds.

|                       |             |             |
|-----------------------|-------------|-------------|
| Viscosity @ 73°F.:    | R Component | 350-400 cps |
|                       | T Component | 150-200 cps |
| Specific Gravity:     | R Component | 1.208       |
|                       | T Component | 1.235       |
| Foam Ratio by Volume: | R Component | 50%         |
|                       | T Component | 50%         |

**PHYSICAL PROPERTIES:**

|   |         |
|---|---------|
| Density, pcf, core                            | 2.7     |
| Compressive Strength, 10% Strain, psi         |         |
| Parallel                                      | 42 - 48 |
| Perpendicular                                 | 25.0    |
| K Factor, Thermal Probe (BTU-in/hr.sq.ft.°F.) |         |
| Initial                                       | 0.114   |
| 7 days @ 140°F.                               | 0.120   |
| 30 days @ 77°F.                               | 0.125   |
| Dimensional Stability, % Volume Change        |         |
| 1 day @ 200°F.                                | 1.5     |
| 1 day @ 110°F. 100% RH                        | 0.7     |
| 7 days @ 158°F. and 100% RH                   | 11.3    |
| 14 days @ 158°F. and 100% RH                  | 14.6    |
| 7 days @ -20°F.                               | 0.9     |

The above data should be used as a guide only in the preparation of material specifications since foam properties are dependent upon processing conditions.

(over)

All polyurethane foam burns in varying degrees which in turn liberates toxic gases and should be evaluated in its final form on meeting existing standards in your industry.

The information presented herein is based on our own research and that of others and is believed to be correct. However, no warranty is expressed or implied. No statement herein extends any license, either expressed or implied, in connection with any patents issued or pending which may be the property of Stepan or others.

## **STEPANFOAM BX-350-7**

**SPRAYING:** The Stepanfoam BX-350-7 spray system has been evaluated using the Binks Model 43P and Gusmer Airless Spray Guns with excellent results. The mechanical mix air atomization guns which have been used to spray Stepanfoam BX-350-7 are Binks Model 18FM, Decker, Demco and Martin Sweets. The equipment manufacturers' recommendations for hose and block temperatures should be followed. Temperature adjustments should be made to adjust for reactivity and spray pattern.

The substrate to be sprayed shall be free of grease, oil, loose particles, moisture and other foreign matter to assure adequate bonding of foam to metal substrate. Cleaning can be accomplished by commercial sandblasting, wire brush or chemical treatment. To protect substrate and enhance adhesion, a prime coat may be applied to the metal surface.

Foam should not be applied unless the surface temperature is 60°F. or higher. The formation of urethane foam involves an exothermic chemical reaction. Therefore, spraying foam below 60°F. will affect foaming rate, adhesion to substrate and physical properties of the resulting foam.

Exterior surface cannot be sprayed during precipitation periods. No foam should be applied to exterior surface until surfaces are thoroughly dry.

Spraying is not recommended with wind velocities greater than 10-15 miles per hour unless wind barriers are used. High wind velocities result in excessive overspray and fumes which will contaminate adjacent work areas.

**STORAGE AND HANDLING:** The R Component should be controlled below 75°F. or handled in a totally enclosed, pressurized system to prevent loss of the fluorocarbon blowing agent. The T Component temperature may vary from 65-110°F.

In order to prevent moisture contamination, all containers should be tightly sealed after each use.

Shelf life is six months in sealed containers at room temperature (60-90°F.).

**CAUTION:** The BX-350-7 foam contains isocyanate and must be used with adequate ventilation. When spraying, air-fed face masks should be worn because of high concentration of isocyanate mist in the atmosphere. Direct contact of the liquid should be avoided. For additional information consult Stepan Chemical Company, Urethane Department, Northfield, Illinois 60093; telephone 312/446-7500.

**NOTE:** For additional information on the BX-350-7 foam consult the following Stepan Technical Bulletins:

1. Urethane Foam for the Construction Industry
2. Application Specifications Re-Roofing Existing Roof With Urethane Foam Spray Systems

# STEPANFOAM™ BX-250 SERIES

## RIGID URETHANE FOAM SYSTEMS

**DESCRIPTION:** The Stepanfoam BX-250 Series foams are designed as spray systems for use as thermal insulation in panels, cavities and roofing applications. The BX-250 Series foams can be applied to plywood, steel, concrete and other various substrates at temperatures of 60°F. to 100°F. The systems are available in varying reactivities to meet your exact requirements.

**PHYSICAL CHARACTERISTICS:** The Stepanfoam BX-250 Spray systems are low viscosity systems specifically formulated to offer the maximum compatibility and ease of atomization necessary for spray applications.

BX-250A - Slow version for cool, horizontal surfaces.

BX-250B - Slowest version for horizontal surfaces.

BX-250D - Fastest version for vertical surfaces.

|                    |             |             |
|--------------------|-------------|-------------|
| Viscosity @ 73°F.: | R Component | 350-400 cps |
|                    | T Component | 150-200 cps |

|                   |             |       |
|-------------------|-------------|-------|
| Specific Gravity: | R Component | 1.208 |
|                   | T Component | 1.235 |

|                       |             |     |
|-----------------------|-------------|-----|
| Foam Ratio by Volume: | R Component | 50% |
|                       | T Component | 50% |

### PHYSICAL PROPERTIES:

|              |     |
|--------------|-----|
| Density, pcf | 2.1 |
|--------------|-----|

|                                       |               |    |
|---------------------------------------|---------------|----|
| Compressive Strength, 10% Strain, psi | Parallel      | 38 |
|                                       | Perpendicular | 17 |

|   |                 |       |
|---|-----------------|-------|
| K Factor, Thermal Probe (BTU-in/hr.sq.ft.°F.) | Initial         | 0.116 |
|   | 7 days @ 140°F. | 0.122 |
|   | 30 days @ 77°F. | 0.127 |
|   |                 |       |

|  |                              |      |
|--|------------------------------|------|
| Dimensional Stability, % Volume Change | 1 day @ 200°F.               | 1.6  |
|  | 1 day @ 110°F. and 100% RH   | 0.8  |
|  | 7 days @ 158°F. and 100% RH  | 11.2 |
|  | 14 days @ 153°F. and 100% RH | 14.7 |

The above data should be used as a guide only in the preparation of material specifications since foam properties are dependent upon processing conditions.

All polyurethane foam burns in varying degrees which in turn liberates toxic gases and should be evaluated in its final form on meeting existing standards in your industry.

The information presented herein is based on our own research and that of others and is believed to be correct. However, no warranty is expressed or implied. No statement herein extends any license, either expressed or implied, in connection with any patents issued or pending which may be the property of Stepan or others.



## STEPANFOAM BX-250 Series

**SPRAYING:** The Stepanfoam BX-250 spray systems have been evaluated using the Binks Model 43P and Gusmer Airless Spray Guns with excellent results. The mechanical mix-air atomization guns which have been used to spray Stepanfoam BX-250 are Binks Model 18FM, Decker, Demco and Martin Sweets. The equipment manufacturers recommendations for hose and block temperatures should be followed. Temperature adjustments should be made to adjust for reactivity and spray pattern.

The substrate to be sprayed shall be free of grease, oil, loose particles, moisture and other foreign matter to assure adequate bonding of foam to metal substrate. Cleaning can be accomplished by commercial sandblasting, wire brush or chemical treatment. To protect substrate and enhance adhesion, a prime coat may be applied to the metal surface.

Foam should not be applied unless the surface temperature is 60°F. or higher. The formation of urethane foam involves an exothermic chemical reaction. Therefore, spraying foam below 60°F. will affect foaming rate, adhesion to substrate and physical properties of the resulting foam.

Exterior surface cannot be sprayed during precipitation periods. No foam should be applied to exterior surface until surfaces are thoroughly dry.

Spraying is not recommended with wind velocities greater than 10-15 miles per hour unless wind barriers are used. High wind velocities result in excessive overspray and fumes which will contaminate adjacent work areas.

**STORAGE AND HANDLING:** The R Component should be controlled below 75°F. or handled in a totally enclosed, pressurized system to prevent loss of the fluorocarbon blowing agent. The T Component temperature may vary from 65-110°F.

In order to prevent moisture contamination, all containers should be tightly sealed after each use.

Shelf life is six months in sealed containers at room temperature (60-90°F.).

**CAUTION:** The BX-250 Series foams contain isocyanate and must be used with adequate ventilation. When spraying, air fed face masks should be worn because of high concentration of isocyanate mist in the atmosphere. Direct contact of the liquid should be avoided. For additional information consult Stepan Chemical Company, Urethane Department, Northfield, Illinois; telephone 312/446-7500.

**NOTE:** For additional information on the BX-250 Series foams consult the following Stepan Technical Bulletins.

- 1 Urethane Foam For The Construction Industry
2. Application Specifications Re-Roofing Existing Roofs With Urethane Foam Spray Systems

*as of 4/17/79*

PIPE INSULATION

*Follow - 4/17/79*

# **CEEL-CO<sup>®</sup>**

## **PROTECTIVE JACKETING SYSTEMS AND COVERINGS**



**"A SEAL ON THE FUTURE"**



### CEEL-TITE 100 SERIES

Ceel-Tite 130 is an extremely high impact plastic. Characterized by its tough glossy surface, it withstands intermittent temperatures of 180°F and continuous surface temperatures from 160°F to -40°F. Easily cleaned and maintained, and simple to repair in case of rupture, it's an ideal jacketing for complete insulation protection in any food plant, particularly in corrosive atmospheres and wash down areas. It is being used with excellent results by many of the largest food producers in the country.

Ceel-Tite 130 pipe insulation jacketing, together with Ceel-Tite 130 fitting covers, including long radius 90° L's and Ceel-Tite 100 adhesive, plus Ceel-Tite 130 flat stock and 90° angles for flat surfaces and corners, gives complete protection for any piping system, including odd and irregular shapes. (See information and specification sheet for full details.)

### CEEL-TITE 300 SERIES

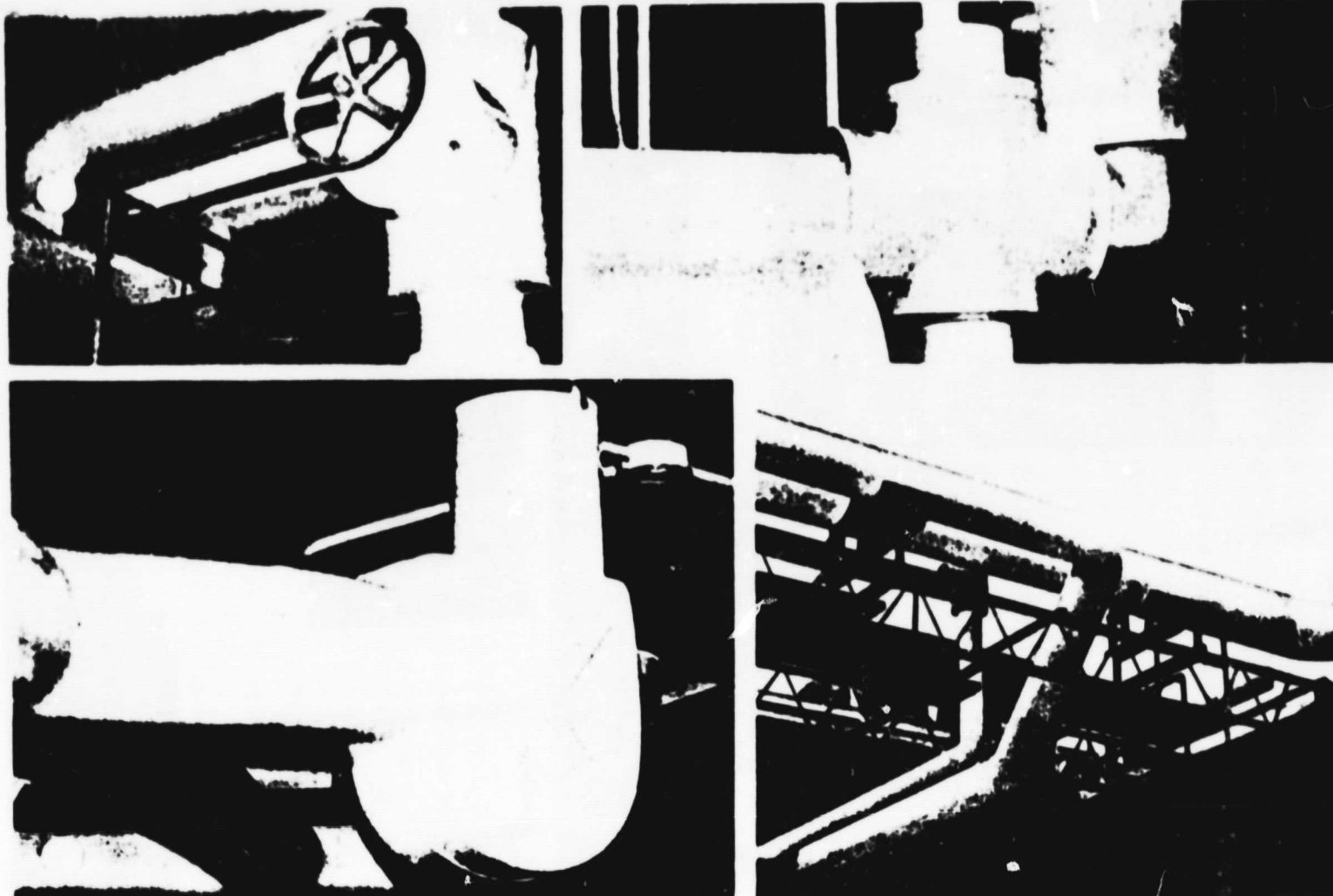
Ceel-Tite 320 and 330 UVR were designed specifically to withstand the weathering and oxidation normally caused by the sun's ultraviolet rays as well as the effects of corrosive and abrasive chemicals. Qualities which make them real money-savers. They are rated self-extinguishing.

Unusual atmospheric conditions such as exist in refineries, pulp mills, chemical plants and other industries using corrosive and abrasive chemicals cause rapid deterioration of most coverings. Because aluminum generally performs unsatisfactorily under these conditions, and coatings, when used, tend to oxidate, crack and peel, unusual and expensive coverings are often required to protect insulated pipes and surfaces.

Tough, resilient, high impact plastic, Ceel-Tite 300 series UVR pipe jacketing and coverings perform where other methods fail. Specify Ceel-Tite for positive protection, minimum costs, and years of maintenance free service, in your choice of attractive high gloss white or mat finish.

As with all Ceel-Tite jacketings, they should be sealed with Ceel-Tite's unique welding adhesive, but may be banded or taped if preferred.

All Ceel-Tite jacketing systems are provided with a minimum one inch overlap for complete protection. Ceel-Tite 300 is a superior jacketing that is realistically priced, easy to install, and will provide years of maintenance free service, outdoor, indoor, or both. (See information sheet for complete details.)



### CEEL-TITE™ 400 SERIES

A liquid plastic coating, Ceel-Tite 423 is formulated from the same resin as the Ceel-Tite 100 Series. Extremely tough and impervious to most contaminants that destroy other coatings, 423 is solvent based, and it may be brushed, rolled or thinned for spraying.

Ceel-Tite 410 and 415 water based primer and sealer are for use on rough or smooth surfaces, respectively, as a base for Ceel-Tite 423. Not for use as a finish coat. (See information and specification sheet for full details.)

### CEEL-TITE™ 500 SERIES (Pan'l-in)

The Ceel-Tite 500 Series includes all insulated panels of any material thickness and combination of surfaces, both front and back. Available in glossy, mat or textured finish. Ceiling panels are available in sizes ranging

from 2' x 4' to 4' x 8'. Standard wall panels are 4' x 8', with special sizes furnished on request. Accessory items necessary for a complete job, such as divider bars, T-bars, corner angles, etc., are available. (See information and specification sheet for full details.)

### CEEL-TITE™ 600 SERIES (Special Shapes and Flat Stock)

The Ceel-Tite 600 Series includes protective coverings for I-beams, box, C-channels, walls, ceilings, hanger rods, uninsulated pipe, sprinkler system piping, electrical conduits, and most structural members where paint failure and metal corrosion is a continuous problem. The ultimate in performance is the Ceel-Tite system. (See information and specification sheet for full details.)

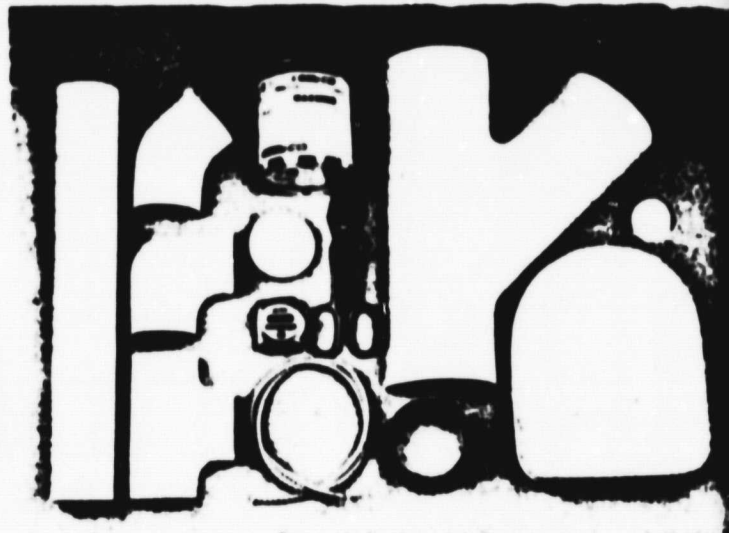
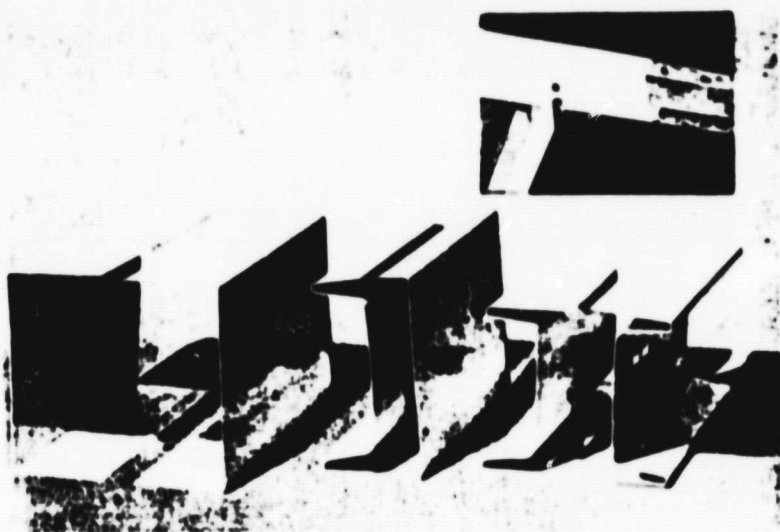
### THE CEEL-TITE™ SYSTEM

Every plant can use a Ceel-Tite™ protective jacketing and covering system. Indoor, outdoor or both. The Ceel-Tite™ system consists of rugged plastic insulation jacketings... fitting covers... I-beam and C-channel covers... rod hanger covers... conduit and wall covers... insulated panels and coatings. For positive protection, Ceel-Tite™ it.

The Ceel-Tite™ system is designed to meet the stringent requirements demanded by U.S.D.A. and F.D.A. regulations. In meeting those requirements demanded by law and consumers alike, all working areas in food or beverage producing facilities must be completely free of contaminants.

Ceel-Tite™ products, properly installed, give complete protection against bacterial growth, dirt accumulation and possible penetration, as well as the





#### **Ceel-Tite System Cont'd.**

destructive effects of corrosive atmospheres. The unique welding adhesive used in the Ceel-Tite™ system assures that all joints required, are positively and permanently sealed. Provisions for expansion may and should be made when required.

The same excellent Ceel-Tite™ performance has proven equally successful in the petro-chemicals field, power and most commercial and industrial applications, including underground. Available in a wide variety of weights and thicknesses, the Ceel-Tite™ system is the answer to the problem of attaining effective dependable insulated pipe and surface protection.

#### **THE CEEL-TITE™ SYSTEM FEATURES**

**A type, size, and shape to fit your needs • Protects against mold, fungus, corrosion, moisture, and many unusual acid or alkaline conditions • Eliminates the need for stainless in many applications and at a much lower cost. • Easily kept clean and bright even under normal daily washdown conditions • Tough...no chipping, cracking, denting or peeling • Eliminates painting...minimum maintenance • Use anywhere...indoor, outdoor, or underground. • Meets U.S.D.A. regulations...non-toxic • Save on expensive job-site fabrication costs with ready to use preformed materials • That's why we say... For positive protection, Ceel-Tite™ it!**

#### **CEEL-TITE™ Product Information Sheets**

Ceel-Tite 100 Series (Jacketing)  
1/876

Ceel-Tite 300 Series UVR (Jacketing)  
5/876

Ceel-Tite 400 Series (Coatings)  
7/876

Ceel-Tite 500 Series (Pan'l-in)  
9/476

Ceel-Tite 600 Series (Specialties)  
11/876

Ceel-Tite Jacketing Methods  
12/876

Thickness Tables  
5-1-76

\*Available upon request.

# **CEEL-CO®**

A Seal on the Future

260 YUMA, DENVER, COLORADO 80223 / PHONE (303) 722-4335 OR (303) 722-1231



SOLAR FLUID  
(ANTIFREEZE)

# UCAR FOODFREEZE 35

A PROPYLENE GLYCOL BASED INDUSTRIAL COOLANT  
AND HEAT TRANSFER FLUID

UNION  
CARBIDE





## Operating Practices — UCAR Foodfreeze 35

|                                  |  |
|----------------------------------|--|
| <b>MATERIALS OF CONSTRUCTION</b> | <ul style="list-style-type: none"><li>• Steel, aluminum, polyethylene, and other common elastomers. Not recommended for use with copper, brass, or galvanized steel.</li></ul>   |
| <b>OPERATING TEMPERATURES</b>    | <ul style="list-style-type: none"><li>• Minimum bulk fluid temperature . . . <math>-33^{\circ}\text{C}</math>.<br/>(at lower temperatures viscosity is a major factor)</li><li>• Maximum bulk fluid temperature, with a high degree of aeration . . . <math>80^{\circ}\text{C}</math>.</li><li>• Maximum bulk fluid temperature, with vent or breather line as a source of air . . . <math>150^{\circ}\text{C}</math>.</li><li>• Maximum skin temperature on UCAR Foodfreeze 35 side of heat exchanger . . . <math>160^{\circ}\text{C}</math>.</li></ul> |
| <b>WATER QUALITY</b>             | <ul style="list-style-type: none"><li>• Use distilled water, deionized water, or soft water containing less than 100 ppm of chloride and/or sulfate ions.</li></ul>  |
| <b>SYSTEM PREPARATION</b>        | <p>Before installing UCAR Foodfreeze 35, be sure system is free from scale, rust, sediment, and residual chlorides if converted from brine systems. The services of a professional cleaner may be required to prepare the system properly.</p>   |
| <b>MINIMUM CONCENTRATION</b>     | <p>To provide adequate corrosion protection, the minimum aqueous concentration of UCAR Foodfreeze 35 should be 20 per cent.</p>  |



**Table 1 — Typical Physical Properties —  
UCAR® Foodfreeze 35**

Determined on typical commercial material

|   |  |
|---|--|
| Specific Gravity at 20/20°C                     | 1.050 to 1.054   |
| Boiling Point at 760 mm Hg                      | 162.0 °C   |
| at 50 mm Hg                                     | 88.5 °C  |
| at 10 mm Hg                                     | 58.2 °C  |
| Vapor Pressure at 20°C                          | 0.66 mm Hg   |
| Freezing Point                                  | -51 °C   |
| Freezing Point of 50% Aqueous Solution          | -27 °C   |
| Viscosity at 0°C                                | 265.8 centipoises  |
| at 20°C   | 63.6 centipoises   |
| at 40°C   | 26.5 centipoises   |
| Refractive Index, $n_D^{20^\circ\text{C}}$      | 1.43042  |
| Specific Heat at 20°C                           | 0.605 cal/(g)(°C)<br>0.605 Btu/(lb)(°F)  |
| Thermal Conductivity at 20°C                    | 0.00050 cal/(sec)(cm <sup>2</sup> )(°C/cm)<br>0.12 Btu/(hr)(ft <sup>2</sup> )(°F/ft) |
| Flash Point                                     |  |
| Concentrate:                                    |  |
| Pensky-Martens closed cup<br>(ASTM method D 93) | 99°C (210°F)   |
| Cleveland open cup<br>(ASTM method D 92)        | 116°C (240°F)  |
| Aqueous solutions:                              |  |
| Pensky-Martens closed cup<br>(ASTM method D 93) | No flash point   |
| Cleveland open cup<br>(ASTM method D 92)        | No flash point   |
| Aqueous solutions (<90%)                        | No flash point   |

**Table 2 — Specifications — UCAR® Foodfreeze 35**

Subject to change without notice

|                                     |  |
|-------------------------------------|--|
| Specific Gravity at 20/20°C         | 1.050 to 1.054   |
| pH at 25°C. of 30% aqueous solution | 8.0 to 10.0  |
| Color                               | Clear (10 Pt-Co. max.)   |
| Suspended Matter                    | Substantially free from dirt, lint, and foreign particles. A slight haze is permissible. |
| Inhibitor Package                   | 2% by wt   |

# Table 3 — Typical Physical Properties for Aqueous Solutions of UCAR® Foodfreeze 35

FREEZING POINTS/BOILING POINTS/SPECIFIC GRAVITIES/REFRACTIVE INDICES

| Per Cent by Volume | Per Cent by Weight | Freezing Point, °F. | Boiling Point, °F. | Specific Gravity, 60/60°F. | Specific Gravity, 40/60°F. | Refractive Index, n <sub>D</sub> 77°F. | Degrees Brix <sup>(b)</sup> |
|--------------------|--------------------|---------------------|--------------------|----------------------------|----------------------------|--|-----------------------------|
| 20                 | 20.6               | 20                  | 214                | 1.021                      | 1.026                      | 1.3550                                 | 14.75                       |
| 21                 | 21.6               | 19                  |                    | 1.022                      | 1.027                      | 1.3561                                 | 15.50                       |
| 22                 | 22.6               | 18                  |                    | 1.023                      | 1.028                      | 1.3572                                 | 16.00                       |
| 23                 | 23.6               | 17                  |                    | 1.024                      | 1.029                      | 1.3583                                 | 16.75                       |
| 24                 | 24.5               | 16                  | 215                | 1.025                      | 1.031                      | 1.3594                                 | 17.50                       |
| 25                 | 25.5               | 15                  |                    | 1.026                      | 1.032                      | 1.3605                                 | 18.25                       |
| 26                 | 26.5               | 14                  |                    | 1.027                      | 1.033                      | 1.3616                                 | 18.75                       |
| 27                 | 27.4               | 13                  |                    | 1.028                      | 1.034                      | 1.3627                                 | 19.50                       |
| 28                 | 28.4               | 12                  |                    | 1.029                      | 1.035                      | 1.3638                                 | 20.25                       |
| 29                 | 29.4               | 11                  | 216                | 1.029                      | 1.037                      | 1.3649                                 | 21.00                       |
| 30                 | 30.3               | 9                   |                    | 1.030                      | 1.038                      | 1.3660                                 | 21.50                       |
| 31                 | 31.3               | 8                   |                    | 1.031                      | 1.039                      | 1.3671                                 | 22.25                       |
| 32                 | 32.3               | 7                   |                    | 1.032                      | 1.040                      | 1.3682                                 | 22.75                       |
| 33                 | 33.3               | 5                   |                    | 1.033                      | 1.041                      | 1.3693                                 | 23.50                       |
| 34                 | 34.3               | 4                   | 217                | 1.034                      | 1.042                      | 1.3703                                 | 24.00                       |
| 35                 | 35.3               | 2                   |                    | 1.035                      | 1.044                      | 1.3714                                 | 24.75                       |
| 36                 | 36.2               | 1                   |                    | 1.036                      | 1.045                      | 1.3725                                 | 25.50                       |
| 37                 | 37.2               | -1                  |                    | 1.037                      | 1.046                      | 1.3736                                 | 26.00                       |
| 38                 | 38.2               | -3                  | 218                | 1.038                      | 1.047                      | 1.3747                                 | 26.50                       |
| 39                 | 39.2               | -4                  |                    | 1.039                      | 1.048                      | 1.3758                                 | 27.25                       |
| 40                 | 40.2               | -6                  |                    | 1.040                      | 1.049                      | 1.3768                                 | 27.75                       |
| 41                 | 41.2               | -8                  | 219                | 1.040                      | 1.050                      | 1.3779                                 | 28.25                       |
| 42                 | 42.2               | -10                 |                    | 1.041                      | 1.050                      | 1.3790                                 | 29.00                       |
| 43                 | 43.2               | -12                 |                    | 1.042                      | 1.051                      | 1.3800                                 | 29.50                       |
| 44                 | 44.1               | -14                 | 220                | 1.043                      | 1.052                      | 1.3811                                 | 30.25                       |
| 45                 | 45.1               | -16                 |                    | 1.044                      | 1.053                      | 1.3821                                 | 30.75                       |
| 46                 | 46.1               | -18                 |                    | 1.045                      | 1.054                      | 1.3832                                 | 31.25                       |
| 47                 | 47.1               | -20                 | 221                | 1.046                      | 1.054                      | 1.3842                                 | 32.00                       |
| 48                 | 48.0               | -22                 |                    | 1.047                      | 1.055                      | 1.3853                                 | 32.50                       |
| 49                 | 49.0               | -25                 |                    | 1.047                      | 1.056                      | 1.3863                                 | 33.00                       |
| 50                 | 50.0               | -27                 | 222                | 1.048                      | 1.057                      | 1.3874                                 | 33.50                       |
| 51                 | 51.0               | -29                 |                    | 1.049                      | 1.057                      | 1.3884                                 | 34.25                       |
| 52                 | 52.0               | -32                 | 223                | 1.049                      | 1.058                      | 1.3895                                 | 34.75                       |
| 53                 | 53.0               | -34                 |                    | 1.050                      | 1.058                      | 1.3905                                 | 35.25                       |
| 54                 | 54.0               | -36                 | 224                | 1.051                      | 1.059                      | 1.3916                                 | 35.75                       |
| 55                 | 55.0               | -39                 |                    | 1.051                      | 1.060                      | 1.3926                                 | 36.25                       |
| 56                 | 56.0               | -41                 | 225                | 1.052                      | 1.060                      | 1.3937                                 | 36.75                       |
| 57                 | 57.0               | -44                 |                    | 1.052                      | 1.061                      | 1.3947                                 | 37.50                       |
| 58                 | 58.0               | -47                 | 226                | 1.053                      | 1.061                      | 1.3957                                 | 38.00                       |
| 59                 | 59.0               | -50                 |                    | 1.053                      | 1.062                      | 1.3967                                 | 38.50                       |
| 60                 | 60.0               | -53                 | 227                | 1.054                      | 1.062                      | 1.3977                                 | 39.00                       |
| 61                 | 61.0               | (a)                 |                    | 1.054                      | 1.063                      | 1.3986                                 | 39.50                       |
| 62                 | 62.1               | (a)                 | 228                | 1.055                      | 1.063                      | 1.3995                                 | 40.00                       |
| 63                 | 63.1               | (a)                 |                    | 1.055                      | 1.063                      | 1.4004                                 | 40.50                       |
| 64                 | 64.1               | (a)                 | 229                | 1.055                      | 1.064                      | 1.4013                                 | 40.75                       |
| 65                 | 65.1               | (a)                 | 230                | 1.056                      | 1.064                      | 1.4022                                 | 40.25                       |

(a) Solution near its freezing point is extremely viscous and hence a true value is not easily determined

(b) Values determined to nearest 0.25 to facilitate readings with the American Optical Refractometer Model 10431

# How to Maintain the Performance of Aqueous Solutions of UCAR® Foodfreeze 35

Table 6 – Properties/Limits

| Aqueous Solutions of UCAR<br>Foodfreeze 35 | Property              | Limits   | Test Method |
|--|-----------------------|--|-------------|
|  | Appearance            | Relatively clear, water-white liquid, low sediment content | A           |
|  | pH                    | 8.0 to 9.6   | B           |
|  | Phosphate Ion Content | 2,000 ppm, minimum   | C           |
|  | Chloride Ion Content  | Less than 100 ppm  | D           |
|  | Freezing Protection   | Allow 5°F. safety factor                                   | E           |

## Test Methods for Measuring the Properties of UCAR® Foodfreeze 35 Solutions

### A/APPEARANCE

Pour representative sample system solution into a suitable, clean, clear, glass flask. Shake the flask and examine visually. A hazy solution may be an indication of the presence of corrosion products or other contamination.

### B/pH

The pH of the sample system solution is best determined by means of a suitable pH meter employing a calomel-glass electrode combination. If circumstances make use of a pH meter impractical, other suitable means such as a pH slide comparator or appropriate

"pHydrion" test papers which change color over a narrow pH range can be employed.

### C/PHOSPHATE ION CONTENT

This method is based on a test kit available from the Taylor Instrument Company, Baltimore, Maryland. Similar apparatus from other suppliers should also be suitable.

### EQUIPMENT AND REAGENTS

1. Base for 5 mil. round test tubes; Catalog No. 531.
2. High phosphate comparator slide, 5 to

(continued)





100 ppm.; Catalog No. 1100.

3. Reagent vial with 0.5 ml. pipet (2); Catalog No. 502A.

4. High phosphate mixing tube (4); Catalog No. 515.

5. Test tubes, 5 ml. capacity (6); Catalog No. 500.

6. Molybdate reagent for phosphate determination, 32 oz.; Catalog No. 601.

7. Stannous chloride reagent for phosphate determination, 4 oz.; Catalog No. 602.

NOTE: Numbers in parentheses are suggested quantities to keep on hand.

### SAMPLE PREPARATION

UCAR Foodfreeze 35 contains phosphate ion. To use the specified equipment to test the solution, an appropriate dilution of the sample system solution should be made to facilitate evaluation on the high phosphate comparator slide (5 to 100 ppm.). For example, if the sample solution is diluted 1:100 (use an appropriate pipet and volumetric flask) and the phosphate ion content of this diluted sample is shown by the slide to be 30 ppm., then simply multiplying 30 by the dilution factor of 100 will give 3,000 ppm. as the phosphate ion content of the original sample system solution.

### TEST PROCEDURE

Add the diluted sample system solution to the first line on the high phosphate mixing tube; the addition is equal to 5 ml. Next add molybdate reagent (as supplied) to the second line on the tube; addition is equal to 10 ml. Stopper the tube and shake. Now add 2.5 ml. of the stannous chloride solution prepared by following the simple directions on the reagent vial, using the marked eye dropper. Stopper and shake. A blue color should develop if phosphate is present.

Transfer this blue colored solution to a 5 ml. test tube, and place it in the center hole on the base. Place two, 5 ml. test tubes of water on both sides of this test solution. Place the 5 to 100 ppm. phosphate slide comparator on the base and compare the various color intensities. Select the one best matching the intensity of the blue colored sample solution. This value,

when multiplied by the dilution factor, should give the phosphate ion content of the original system solution.

### ADJUSTING OF SYSTEM SOLUTION

When an adjustment is necessary, the addition should be based upon the fact that adding 1.5 pounds of dipotassium hydrogen phosphate ( $K_2HPO_4$ ) to each 100 gallons of system solution is equivalent to adding approximately 1,000 ppm. of phosphate ion.

A good grade phosphate salt, low in chloride and sulfate ion content, should be employed and be predissolved in either water or a portion of the glycol coolant apart from the system.

### D/CHLORIDE ION CONTENT

The necessity of determining the chloride ion content is usually governed by its content in the water employed for dilution. Actually, the use of distilled or deionized water is suggested unless the overall hardness of the proposed water is known to be low. Details for the procedure are available on request.

### E/FREEZING PROTECTION

To determine the freezing protection safety factor, use the appropriate physical property information given in Table 3 for aqueous solutions of UCAR Foodfreeze 35. Freezing points/UCAR Foodfreeze 35 concentrations are best determined by refractive index. An inexpensive, hand-held refractometer, Model 10431, is available through American Optical Corp., Scientific Instrument Division, Buffalo, New York 14215. Reliance on specific gravity should be approached with caution due to the relatively small change in reading which occurs with increase in UCAR Foodfreeze 35 concentration, especially in the upper concentration region. It should be noted that the specific gravity versus composition curve passes through a maximum at about 75 per cent UCAR Foodfreeze 35. Because of this phenomenon, double check specific gravity readings for solutions containing above 50 per cent UCAR Foodfreeze 35 by an appropriate water dilution which can then be extrapolated back to the original.

FLOOD ALARM

OR IMPLIED, AND THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY EXCLUDED BEYOND THE ONE (1) YEAR DURATION OF THIS WARRANTY.

If the detector is defective, package it carefully, along with proof of purchase (including the date of purchase) and a short description of the malfunctions, and mail it, postage prepaid, to the following address:

## **Datasonic Inc.**

150 West Pine Street  
Long Beach, New York 11561

### **NEW ADDRESS**

**DATASONIC, INC.**  
**255 EAST SECOND STREET**  
**MINEOLA, NEW YORK 11501**

### **NOTES**

- Do not totally immerse FLOOD ALERT in water. It will not function.
- FLOOD ALERT will activate when water contacts the "water sensors". Alarm will cease and reset automatically when dry.
- Every few months, test FLOOD ALERT by touching both "water sensors" to a wet sponge or cloth.
- Replace battery yearly or after FLOOD ALERT alarm has sounded continuously for more than 24 hours.

# **FLOOD ALERT™**

## **Water Sensing Alarm**

### **OPERATING INSTRUCTIONS**

1. Open case by inserting screwdriver in slots on bottom of the case. Gradually pry each end up until the case separates.
2. Install a fresh 9 volt alkaline battery.
3. Close case by pushing the bottom evenly into the top.
4. Before installing, test FLOOD ALERT by touching both "water sensors" to a wet sponge or cloth. A loud, high-pitched beeping sound will be heard.
5. Place FLOOD ALERT in desired location. BE SURE BOTH "WATER SENSORS" ARE TOUCHING THE SURFACE WHERE WATER IS TO BE DETECTED.

### **LIMITED WARRANTY**

Datasonic, Inc. warrants to the consumer that its FLOOD ALERT water detector will be free from defects in workmanship or materials, under normal use and service, for a period of one (1) year from the date of original purchase by a consumer. If, at any time during the warranty period, the detector is defective or malfunctions, Datasonic shall replace it within a reasonable period of time by shipping a replacement unit to the consumer, postage prepaid. This warranty shall not apply if it is shown by Datasonic that the defect or malfunction was caused by damage which occurred while the detector was in the possession of a consumer. Datasonic's sole responsibility shall be to replace the detector within the terms stated above.

**DATASONIC SHALL NOT BE  
LIABLE FOR ANY CONSEQUENTIAL  
DAMAGES RESULTING FROM  
ANY BREACH OF ANY WARRANTY,  
EXPRESS OR IMPLIED, APPLIC-  
ABLE TO THIS PRODUCT. THIS  
WARRANTY IS IN LIEU OF ALL  
OTHER WARRANTIES, EXPRESS**

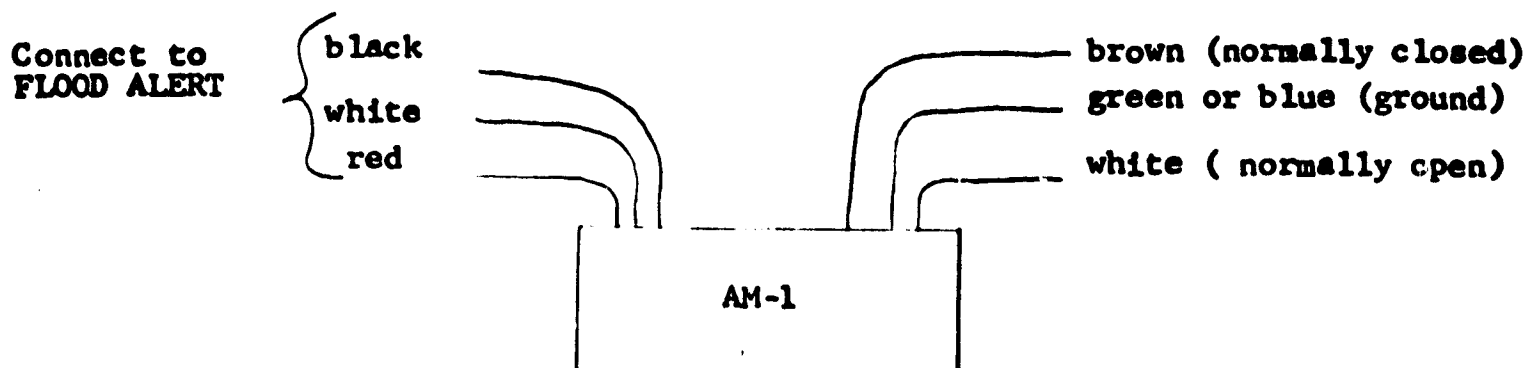
**ORIGINAL PAGE IS  
OF POOR QUALITY**

# Datasonic Inc.

150 West Pine Street, Long Beach, New York 11561 - (516) 889-4078

## INSTRUCTIONS FOR AM-1 - (AUXILIARY OUTPUT MODULE)

1. Remove two metal eyelets which hold circuit board to case.
2. Remove circuit board.
3. Drill approximately 3/16" hole on side of case top.
4. Insert black, white and red wires from AM-1 through hole in case.
5. Solder black wire to hole marked GRD.
6. Solder white wire to hole marked AUX.
7. Solder red wire to red battery lead wire.
8. Insert 47K ohm resistor as shown on diagram. NOTES- Some circuit boards will already have this part installed.
9. Place circuit board back into case base.
10. Use pliers or vise to re-install two metal eyelets (supplied).
11. To have unit emit a steady tone or pulse only once, remove .22 MFD capacitor from circuit board.
12. Close case and test for proper functioning.



MICRO COMPUTER

## System Two Disk Computer (cont'd)

### TECHNICAL SPECIFICATIONS System Two Disk Computer System

**Processor:** 4 MHz version Z-80  
**Cycle time:** 250 nanoseconds  
**Minimum instruction execution time:**  
1 microsecond  
**Instruction set:** 158 instructions including the  
78 instructions of the 8080  
**System bus:** Industry standard S-100  
**Board capacity:** 21 boards  
**Disk drive capacity:** 2 drives (supplied)  
**Disk storage capacity:** 184K bytes each disk  
**RAM memory:** 64K bytes  
**Printer interface:** Supports Cromemco dot-matrix  
or fully-formed-character printers

**PROM firmware:** 1K bytes (2708 PROM)  
**Serial interface:** RS-232 or current loop; 110 to  
76,800 baud. Supports Cromemco CRT terminal.  
**Parallel interface:** 8 bit TTL level  
**Power supply:** +8 volts @ 30A, +18 volts @ 15A,  
-18 volts @ 15A  
**Power:** Operates from 110/220 volts; 50/60 cycle  
**Operating environment:** 0-55°C  
**Dimensions:** 12 1/4" H x 19" W x 20 1/4" D  
(31.1 x 48.3 x 52.7 cm)  
**Weight:** 49 lbs (22 kg)  
**Mounting:** For rack mounting (optional cabinets  
available)

## Z-2 Computer System

### Z-2 COMPUTER SYSTEM

The Model Z-2 is a building-block computer. It includes the popular Cromemco ZPU processor card and a heavy-duty power supply, all housed in a rugged metal rack-mount cabinet.

The computer further includes spaces for 21 circuit boards so that you can install memory, I/O, or custom circuits as your needs require.

### PRICE

Model Z-2W Computer, fully assembled ..... \$995.

Z-2 is supplied for rack mounting.  
Attractive bench cabinet shown is also available.



### TECHNICAL SPECIFICATIONS Z-2 COMPUTER SYSTEM

**Processor:** 4 MHz version Z-80  
**Cycle time:** 250 nanoseconds  
**Minimum instruction execution time:** 1 microsecond  
**Instruction set:** 158 instructions including the 78  
instructions of the 8080  
**System bus:** industry standard S-100  
**Board capacity:** 21 boards  
**Power:** Operates from 110/220 volts; 50/60 cycles

**Power supply:** +8 volts @ 30A, +18 volts @ 15A,  
-18 volts @ 15A  
**Operating environment:** 0-55°C  
**Dimensions:** 12 1/4" H x 19" W x 20 1/4" D  
(31.1 x 48.3 x 52.7 cm)  
**Weight:** 39 lbs (18 kg)  
**Mounting:** For rack mounting (optional bench cabinet  
available)



U.P.S.

(Uninterruptable Power Supply)

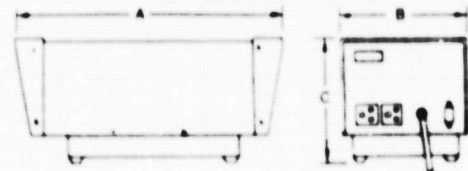
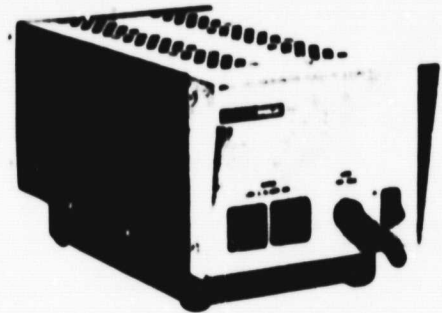
# Sola Minicomputer Regulators

The Sola Micro/Mini Computer Ultra Isolated Regulator provides instantaneous voltage regulation, and ultra isolation from both transverse and common mode noise for any type of load. It also suppresses transients, protects against overloads and serves as a portable dedicated line. It is the ultimate in AC line conditioning equipment.

The Sola "Micro/Mini" is particularly applicable in systems involving mini or micro computers, POS equipment, micro-processors, or data terminals — where noise and transients cause errors, or low voltage and short term disruptions can result in loss of memory. The output waveshape is sinusoidal and contains less than 3% harmonic distortion, making it ideal for any electronic load.

Common mode noise rejection exceeds 120 db for the regulator, while transverse noise rejection is better than 60 db — true ultra-isolation. Brownout protection is a real bonus feature. Input line voltage variations as great as  $\pm 15\%$  are instantaneously regulated to a maximum output deviation of  $\pm 3\%$ . And, the output will remain within NEMA voltage specifications for input voltages as low as 65% of nominal.

The portable 140 to 2000VA models are designed for office type environments and have a low sound level of 43 db.



NOTE: 2000 VA MODELS HAVE 30 AMP TWIST RECEPTACLE

U.L. LISTED

## Portable Models

### 60 Hertz Single Phase

| Maximum Output VA Rating | Nominal Output Voltage | Input Voltage Range | Catalog Number | Approx. Shipping Weight | Dimensions |       |       |
|--------------------------|------------------------|---------------------|----------------|-------------------------|------------|-------|-------|
|                          |                        |                     |                |                         | A          | B     | C     |
| 140                      | 120                    | 95-130              | 63-13-114      | 18                      | 14.00      | 6.00  | 5.56  |
| 250                      | 120                    | 95-130              | 63-13-125      | 31                      | 15.60      | 8.12  | 7.31  |
| 500                      | 120                    | 95-130              | 63-13-150      | 47                      | 18.60      | 8.92  | 8.68  |
| 750                      | 120                    | 95-130              | 63-13-175      | 60                      | 18.60      | 8.92  | 8.68  |
| 1000                     | 120                    | 95-130              | 63-13-210      | 75                      | 18.60      | 8.92  | 8.68  |
| 2000                     | 120                    | 95-130              | 63-13-220      | 125                     | 18.84      | 11.38 | 10.62 |

\*For  $\pm 3\%$  output regulation. Unit will operate at lower voltage.

### 50 Hertz Single Phase††

| Maximum Output VA Rating | Nominal Output Voltage | Input Voltage Range | Catalog Number | Approx. Shipping Weight | Dimensions |       |       |
|--------------------------|------------------------|---------------------|----------------|-------------------------|------------|-------|-------|
|                          |                        |                     |                |                         | A          | B     | C     |
| 140                      | 220                    | 180-260             | 63-13-614      | 22                      | 15.60      | 8.12  | 7.31  |
| 250                      | 220                    | 180-260             | 63-13-625      | 35                      | 15.60      | 8.12  | 7.31  |
| 500                      | 220                    | 180-260             | 63-13-650      | 53                      | 18.60      | 8.92  | 8.68  |
| 1000                     | 220                    | 180-260             | 63-13-710      | 85                      | 18.60      | 8.92  | 8.68  |
| 2000                     | 220                    | 180-260             | 63-13-720      | 140                     | 18.84      | 11.38 | 10.62 |

††50 Hertz units not U.L. Listed

U.L. LISTED

## Hard-Wired Models

### 60 Hertz Single Phase (Hard-wired)

| Voltage Rating   |                             | VA    | Catalog Number | App. Ship Wt. (lbs.) | Fig. No. | Dimensions (inches) |       |       |        |        |       |       |               |   |   |
|------------------|-----------------------------|-------|----------------|----------------------|----------|---------------------|-------|-------|--------|--------|-------|-------|---------------|---|---|
| Regulated Output | Input Range                 |       |                |                      |          | A                   | B     | C     | D      | E      | F     | G     | H             | I | J |
| 120              | 175-235-190-260<br>x380-520 | 120   | 63-23-112      | 14                   | 1        | 7 1/4               | 5 1/4 | 3 1/4 | 4      | 3 1/2  | 3     | 2 1/2 | 1 1/2 x 1 1/2 |   |   |
|                  |                             | 250   | 63-23-125      | 28                   | 1        | 9                   | 7 1/4 | 4 1/4 | 5 1/4  | 4 1/2  | 4     | 2 1/2 | 1 1/2 x 1 1/2 |   |   |
|                  |                             | 500   | 63-23-150      | 40                   | 1        | 15                  | 8 1/4 | 5 1/4 | 9      | 8 1/2  | 5 1/2 | 3 1/2 | 1 1/2 x 1 1/2 |   |   |
|                  |                             | 750   | 63-23-175      | 54                   | 1        | 16 1/2              | 8 1/4 | 5 1/4 | 9      | 8 1/2  | 5 1/2 | 3 1/2 | 1 1/2 x 1 1/2 |   |   |
|                  |                             | 1000  | 63-23-210      | 68                   | 1        | 17 1/2              | 8 1/4 | 5 1/4 | 9      | 8 1/2  | 5 1/2 | 4     | 1 1/2 x 1 1/2 |   |   |
|                  |                             | 1500  | 63-23-215      | 105                  | 2        | 19 1/2              | 9 1/4 | 5 1/4 |        | 11 1/2 | 6 1/2 | 5 1/2 | 1 1/2 x 1 1/2 |   |   |
|                  |                             | 2000  | 63-23-220      | 140                  | 2        | 19 1/2              | 9 1/4 | 5 1/4 |        | 11 1/2 | 6 1/2 | 5 1/2 | 1 1/2 x 1 1/2 |   |   |
| 120/240          | 95-130-175-235<br>x190-260  | 8000  | 63-25-230-3    | 144                  | 2        | 21 1/2              | 9 1/4 | 5 1/4 |        | 11 1/2 | 6 1/2 | 5 1/2 | 1 1/2 x 1 1/2 |   |   |
|                  |                             | 10000 | 63-25-230      | 146                  | 2        | 21 1/2              | 9 1/4 | 5 1/4 |        | 11 1/2 | 6 1/2 | 5 1/2 | 1 1/2 x 1 1/2 |   |   |
|                  | 95-130-175-235<br>x190-260  | 5000  | 63-25-250      | 335                  | 3        | 20 1/2              | 9 1/4 | 5 1/4 | 22 1/2 | 24 1/2 | 5 1/2 | 5 1/2 | 1 1/2 x 1 1/2 |   |   |
|                  |                             | 5000  | 63-25-250      | 342                  | 3        | 20 1/2              | 9 1/4 | 5 1/4 | 22 1/2 | 24 1/2 | 5 1/2 | 5 1/2 | 1 1/2 x 1 1/2 |   |   |
|                  | 190-260-380-520             | 7500  | 63-25-275      | 542                  | 1        | 20 1/2              | 9 1/4 | 5 1/4 | 35 1/2 | 37 1/2 | 5 1/2 | 5 1/2 | 1 1/2 x 1 1/2 |   |   |

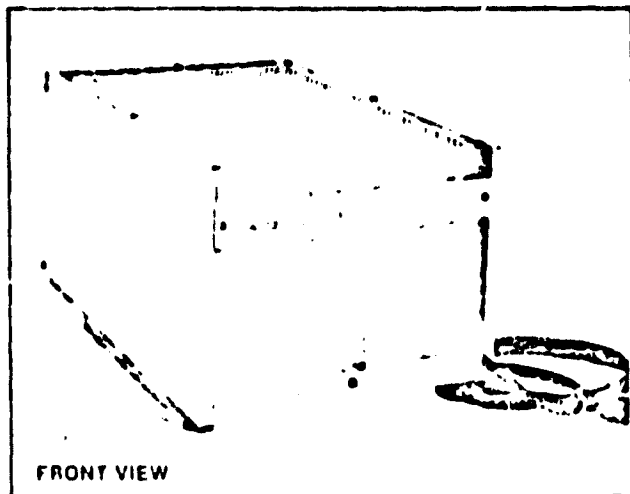
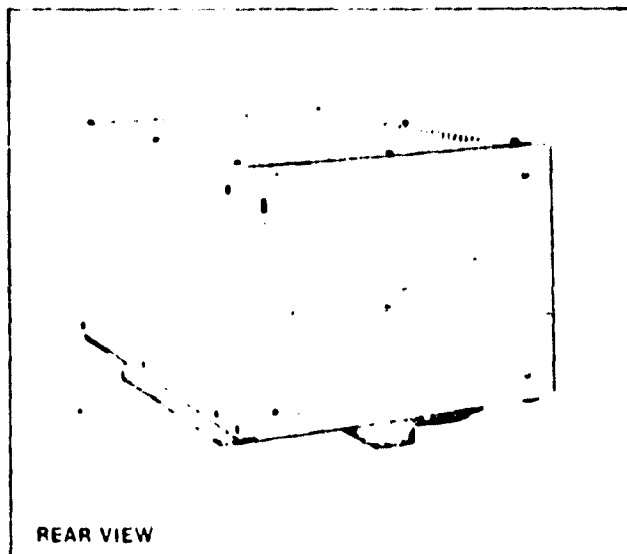


FIGURE 1



## 1.0 INTRODUCTION

**1.1** Sola Electric Mini Uninterruptible Power Supply (UPS) systems provide continuous, regulated noise-free AC power to critical load applications. These are totally integrated units containing rectifier/battery charger, battery and inverter. The rectifier converts the input AC line to DC, maintaining the battery fully charged and simultaneously providing DC power to the inverter. The battery continues to power the inverter when the input AC line fails. The inverter converts DC power to regulated sine wave AC output.

**1.2** The Mini UPS systems are of the on-line type, with the inverter supplying AC power to the critical load at all times. Figure 1 shows a typical Mini UPS system.

TABLE 1 — STANDARD MODELS

| Catalog Number     | Output Power (At 0.8 PF) | Input/Output Frequency | Input/Output Voltage | Battery Back-Up Time | Approx. Weight |
|--------------------|--------------------------|------------------------|----------------------|----------------------|----------------|
| 26-00-50100-3X00   | 400 VA                   | 60 Hz                  | 120 VAC              | 10 minutes           | 85 lbs.        |
| 26-00-50400-3X01   | 400 VA                   | 60 Hz                  | 120 VAC              | 20 minutes           | 100 lbs.       |
| 26-00-50750-3X00 * | 750 VA *                 | 60 Hz *                | 120 VAC *            | 10 minutes *         | 120 lbs.       |
| 26-14-50300-3X00   | 300 VA                   | 50 Hz                  | 220 VAC              | 12 minutes           | 100 lbs.       |
| 26-16-50300-3X00   | 300 VA                   | 50 Hz                  | 240 VAC              | 12 minutes           | 100 lbs.       |
| 26-14-50300-3X01   | 300 VA                   | 50 Hz                  | 220 VAC              | 24 minutes           | 115 lbs.       |
| 26-16-50300-3X01   | 300 VA                   | 50 Hz                  | 240 VAC              | 24 minutes           | 115 lbs.       |
| 26-14-50600-3X00   | 600 VA                   | 50 Hz                  | 220 VAC              | 12 minutes           | 125 lbs.       |
| 26-16-50600-3X00   | 600 VA                   | 50 Hz                  | 240 VAC              | 12 minutes           | 135 lbs.       |

\* X is 0 for standard units and X is 1 for units with battery supplying power annunciation

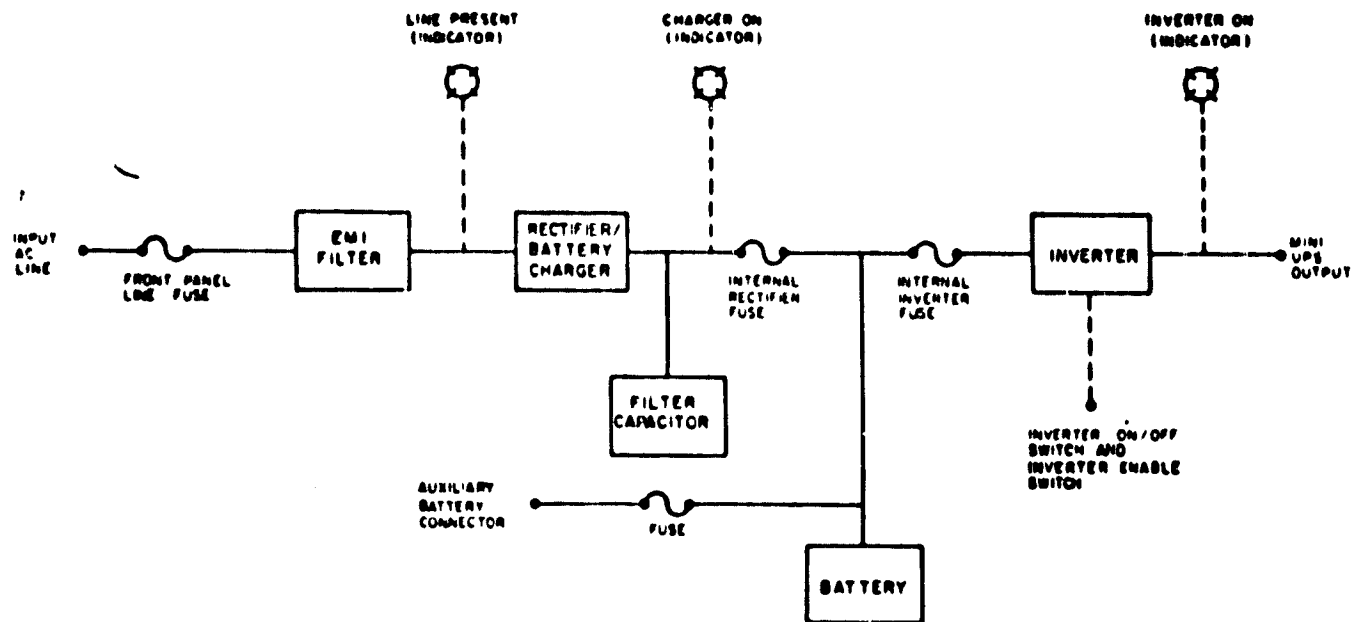


FIGURE 2—TYPICAL MINI UPS SYSTEM ILLUSTRATION

## 5.0 GENERAL DESCRIPTION

- 5.1** A description of the Mini UPS systems and a brief discussion on the operation is presented. This should be read before initial startup – so as to assist in verifying proper operation or detecting possible defects.
- 5.2 Controls** – The Mini UPS has only two (2) control switches, labelled INVERTER ON/OFF and INVERTER ENABLE. The INVERTER ENABLE switch is located on the rear panel and is screwdriver operated – this is provided as a safety feature to prevent the inverter from being accidentally turned on. The INVERTER ON/OFF switch is located on the front panel and controls inverter operation. Note that the rectifier cannot be switch-

ed on or off; it operates whenever the input line cord is plugged into a mating source and the AC line is present.

- 5.3 Indicators** – The Mini UPS has three (3) lamps on the front panel, labelled LINE PRESENT, CHARGER ON and INVERTER ON. The LINE PRESENT and CHARGER ON lamps should always illuminate together unless a fault exists in the rectifier/charger. The INVERTER ON lamp illuminates when AC voltage is present at the inverter output.

- 5.4 Fuses** – An AC LINE FUSE is provided on the front panel to protect the rectifier. The output of the rectifier and input to the inverter are also fused, but these are not user replaceable.

## 7.0 INITIAL TURN ON

**7.1** The purpose of this procedure is to familiarize the user with the Mini UPS controls and indicators, as well as to verify that no significant damage has occurred to the unit in transit.

1. Set the INVERTER ON/OFF rocker switch located on the front panel of the Mini UPS to the OFF position.
2. Connect the input line cord to an appropriate source.
3. Note that the 'LINE PRESENT' and 'CHARGER ON' lamps illuminate. Should this not occur, verify that AC voltage is present at the source - if it is, check the AC LINE FUSE on the front panel and replace if necessary. Contact your SOLA ELECTRIC representative or the Factory if a problem persists.
4. With the above mentioned lamps illuminated, the rectifier is operating and charging the battery. Let the unit run for thirty (30) minutes and check that no smoke or odor emanates from the system enclosure.
5. Set the INVERTER ENABLE switch, located on the rear panel to ON.
6. Set the INVERTER ON/OFF switch to ON.
7. The INVERTER ON' light should gradually illuminate since the inverter takes up to 20 seconds to walk up.
8. Turn the inverter off. Let the rectifier run for twenty-four (24) hours. This is to ensure that the battery is fully charged before the unit is put into operation.
9. Turn the inverter on and verify that the 'INVERTER ON' lamp illuminates.
10. Unplug the input line cord and verify that the

inverter continues to operate - only the 'INVERTER ON' lamp should remain illuminated.

11. Turn the inverter off - the unit is ready for operation.

## 8.0 OPERATING INSTRUCTIONS

1. Plug the critical load into the receptacle on the front panel of the unit.

**NOTE:** With the input line cord plugged into an appropriate source, the rectifier operates at all times - and is not switched on-off.

2. Turn the inverter on. Depending on the amount of inrush current the critical load draws, the inverter may shutdown once or twice due to overload before remaining on. Motors, transformers, cold incandescent lamps and power supplies are types of loads that can draw high starting currents. The unit will remain off after the third overload shutdown. To restart the inverter, toggle the INVERTER ON/OFF switch OFF-ON.
3. To restart the inverter after shutdown due to discharge battery or overtemperature, toggle the INVERTER ON/OFF switch OFF-ON.

## 9.0 AUXILIARY BATTERY CONNECTION

- 9.1 To extend the battery back-up time, SOLA ELECTRIC auxiliary battery packs are available. Each Mini UPS has a special two-terminal socket just below the rear panel to allow mating with an auxiliary battery pack. Each auxiliary battery pack has two connectors permitting the use of more than one pack with a Mini UPS system. See Section 13.1.

## 10.0 MAINTENANCE

- 10.1 The Mini UPS systems are warranted for a period of one (1) year upon delivery to the ultimate user. Conditions of the warranty are given on the warranty page on this manual.

- 10.2 It is recommended that the unit be calibrated every 12 months as a preventive maintenance tool and also to verify performance. The characteristics to be checked and, if necessary, recalibrated are:

1. Inverter Control Voltage
2. Output Voltage
3. Output Frequency
4. DC bus (Battery) Voltage

- 10.3 Refer to Figure 4 for location of the internal potentiometers that may have to be adjusted. A multimeter (such as JOHN FLUKE, Model 8020A) readout is required to check items 1, 2 and 4. The output frequency can be checked by a frequency meter (such as JOHN FLUKE, Model 1900A) or a general purpose oscilloscope (such as TEKTRONIX 1655).

### CAUTIONS

**DANGEROUS VOLTAGES EXIST INSIDE THE MINI UPS ENCLOSURE WITH AND WITHOUT THE INPUT LINE CORD PLUGGED INTO A MATING SOURCE. ONLY TRAINED PERSONNEL SHOULD ATTEMPT TO SERVICE THIS EQUIPMENT.**

**THERE IS NO ISOLATION TRANSFORMER AT THE INPUT TO THE RECTIFIER. HENCE THE COMMON CIRCUITS ON THE INVERTER CONTROL BOARD AND THE BATTERY NEGATIVE TERMINAL CANNOT BE EARTH GROUNDING. THIS PRESENTS ADDITIONAL HAZARD TO THE SERVICE TECHNICIAN AND SAFE PRACTICES MUST BE MAINTAINED, SUCH AS USING INSULATED TOOLS AND PROBES.**

**THE COMMON CIRCUITS ON THE RECTIFIER CONTROL CARD ARE DIRECTLY CONNECTED TO THE BATTERY POSITIVE TERMINAL, WHICH IS COMMON WITH THE INPUT AC LINE THROUGH THE RECTIFIER. HENCE EARTH GROUND CANNOT BE APPLIED AND ADDITIONAL PRECAUTIONS, AS ABOVE, MUST BE MAINTAINED.**

**10.4 Access to the calibration potentiometers is illustrated in Figure 3.**

**10.5 Performance and Calibration** - the following procedure should be used:

**Step 1:** Remove the top cover as illustrated in Figure 3. Do not remove the printed circuit cards.

**Step 2:** Turn the inverter ON. The INPUT LINE CORD SHOULD NOT BE PLUGGED INTO A SOURCE.

**Step 3: INVERTER CONTROL VOLTAGE** - This should be between 11.9 volt and 12.1 volt. Measure this at TP3 on the INVERTER CONTROL CARD and, if necessary, adjust potentiometer RE50 to set to the correct voltage (use TP6 as the common).

**Step 4: OUTPUT VOLTAGE** - Measure this by inserting the multimeter voltage probes into the AC receptacle on the front panel. Adjust potentiometer RE91 on the INVERTER CONTROL CARD to set the voltage to the rated value.

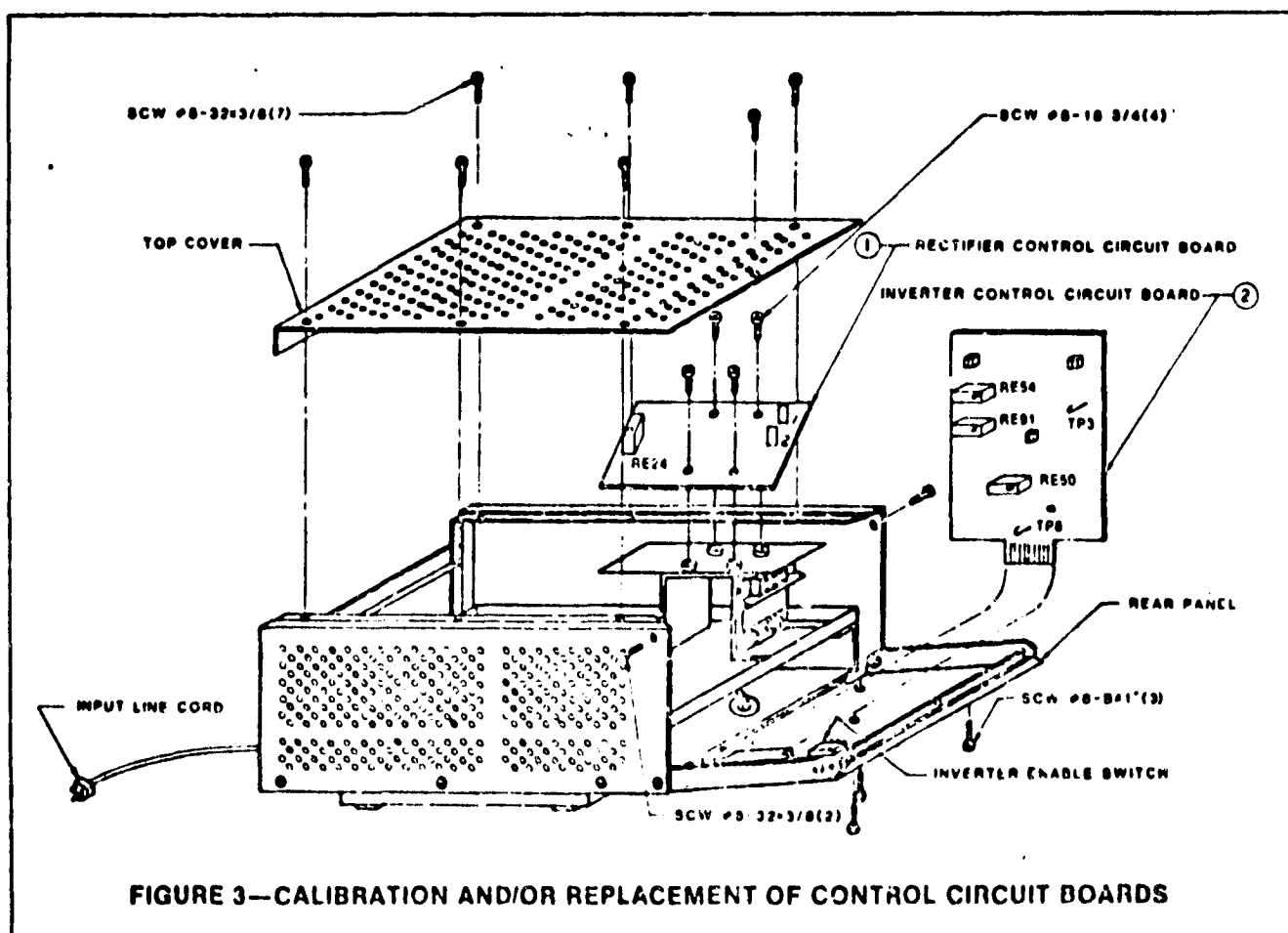
**Step 5: OUTPUT FREQUENCY** - Measure this by inserting oscilloscope or frequency

meter probes into the AC receptacle on the front panel. Adjust potentiometer RE54 on the INVERTER CONTROL CARD to set the frequency to the rated value.

**Step 6:** Turn the inverter OFF.

**Step 7:** Plug the input line cord into an appropriate source. The 'LINE PRESENT' and 'CHARGER ON' lamps should illuminate.

**Step 8: DC BUS VOLTAGE** - With the inverter off, measure the DC bus (battery) voltage at terminals 1(+) and 2(-) on the RECTIFIER CONTROL CARD. OBSERVE ABOVE MENTIONED CAUTIONS. The measured voltage should be between 85.0 volt and 87.0 volt. If the voltage is low, note the exact value and set it to 86.0 volt by adjusting potentiometer RE24. Let the rectifier run for 60 minutes - and then check that the bus voltage has not increased. If it has, the battery is taking charge and has not yet reached a steady state value. Should this occur, set the bus voltage back to the original value noted and operate the unit overnight. Repeat the procedure after the battery is charged.



**FIGURE 3—CALIBRATION AND/OR REPLACEMENT OF CONTROL CIRCUIT BOARDS**



## 11.0 BATTERY LIFE AND REPLACEMENT

**11.1** The battery is kept at float voltage (fully charged) under normal operating conditions. Since every battery has a finite float life and can only undergo a limited number of discharge/charge cycles, it may become necessary to replace it. A useful lifetime cannot be predicted because of the number of variables involved, such as rate of discharge, depth of discharge and operating temperature. The user should determine that the battery needs replacement when it cannot power the inverter more than 60% of its rated back up time - after having been operated at float voltage for more than 16 hours. The following procedure should be used for replacement of the battery (refer to Figure 4):

- Step 1 Unplug the input line cord and the critical load. Make sure the inverter is OFF - (also unplug any auxiliary batteries being used).
- Step 2 Open the rear panel as illustrated in figure 4 and remove the two fuses FU1 and FU2.
- Step 3 Set the unit on its side and remove the battery compartment (note that replacement involves the entire string of 36 cells and the battery case, rather than individual cells).
- Step 4 Detach the battery interconnecting cable.
- Step 5 Repeat the above steps in reverse order to install the new battery.

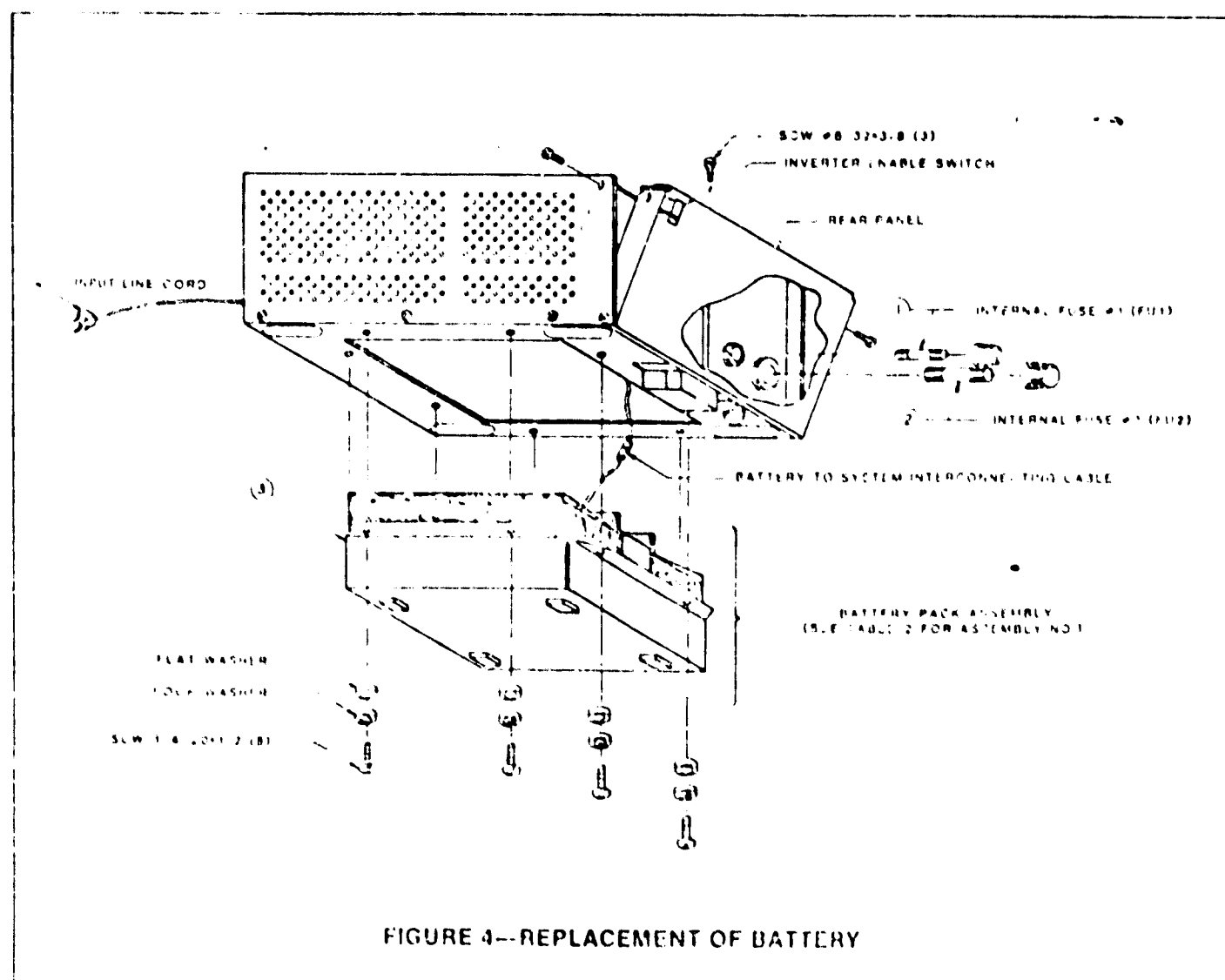


FIGURE 4--REPLACEMENT OF BATTERY

## 12.0 REPLACEABLE PARTS

- 12.1** In consultation with the Factory, some electrical parts may be replaced in the field, such as the battery (section 11.0) and the printed circuit card assemblies. Figure 3 illustrates the removal and replacement of the card assemblies. Various mechanical parts that might be physically damaged may also be replaced in the field - Figure 5 il-

lustrates the removal and replacement of these parts. Table 2 lists the replaceable parts called out in the exploded views of Figures 3, 4 and 5. In addition to the SOLA ELECTRIC part number, the Mini UPS catalog number should also be referred to when ordering spare parts.

## ACCESSORIES

- 13.1** Auxiliary Battery Packs - The length of time the Mini UPS system will supply a load after the input AC line has failed is determined by the battery capacity (and, of course, the amount of power drawn by the load). Normal back-up times are specified at rated load with the internal battery for all models. Should longer back-up time be required, an external battery can be connected to the system. Each Mini UPS system has a fused connector to allow for this provision. Refer to SOLA ELECTRIC AUXILIARY BATTERY literature for specific details.
- 13.2** Battery Supplying Power Signal - In certain applications it is necessary to have an automatic early

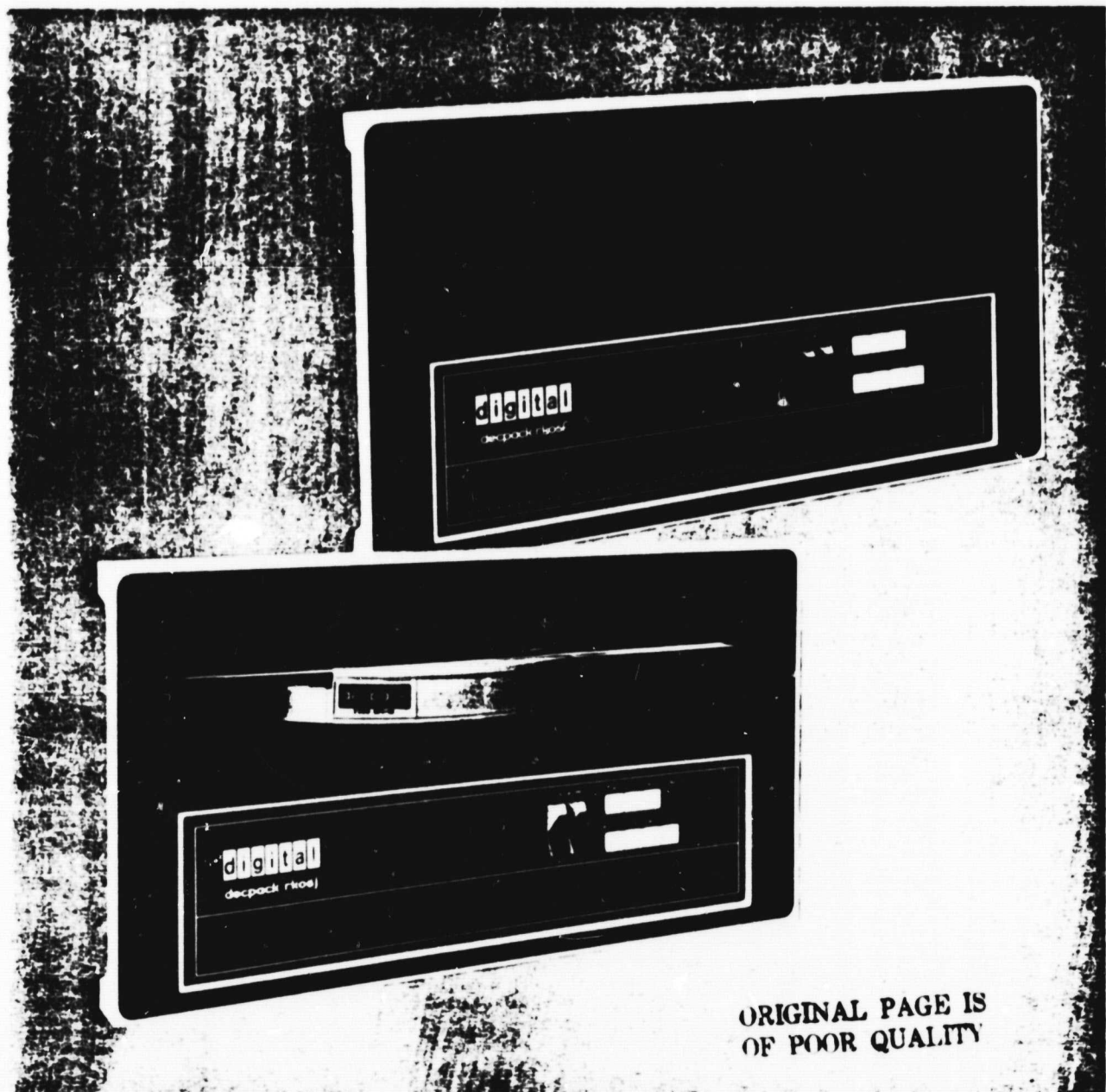
warning signal that the system is in the emergency mode - and may shutdown due to discharged battery. A set of normally open contacts can be provided to mate with the user's circuits. These contacts close only when the inverter is actually operating and the battery is the only source of DC power. A 3-terminal phone jack is used for connection to the user's circuits. The corresponding mating plug would be of the tip, ring and sleeve (3 terminal) type with 0.25 inch sleeve diameter. The sleeve is automatically earth grounded since the phone jack is mounted on the chassis - which in turn is grounded by the input AC line cord. The tip and ring connect to the relay contacts, which are rated 0.15 amp at 30 VAC or 30 VDC.

PDP - II DISK SYSTEM

# PERIPHERALS

JULY 1976

## RK05 Disk System Family



ORIGINAL PAGE IS  
OF POOR QUALITY

digital

LINE PRINTER

**A465221B**

# **MAINTENANCE MANUAL**

## **LINE PRINTER MODEL LP635I**

ALL RIGHTS RESERVED. THIS  
DOCUMENT MAY NOT BE COPIED  
WITHOUT WRITTEN PERMISSION  
OF POTTER INSTRUMENT CO.



**POTTER INSTRUMENT COMPANY, INC.**

**EXECUTIVE DRIVE**

**PLAINVIEW NEW YORK 11803**

**516-681-3200**

**603-732-1991**



C R T

# DUMB TERMINAL. SMART BUY.

ADM-3A  
addressable cursor



## SPECIFICATIONS

### DISPLAY

12" (diagonally measured) rectangular CRT screen with P4 phosphor and bonded etched non-glare surface.

### DISPLAY FORMAT

Standard. 960 characters, displayed in 12 lines of 80 characters per line.

### CHARACTER SET

Standard. 64 ASCII characters, displayed as upper case, plus punctuation and control.

### CHARACTER GENERATION

5 x 7 dot matrix.

### REFRESH RATE

60 Hz standard.

### NUMBER OF KEYS

59 (plus TTY control keys).

### DIMENSIONS

13.5" high x 15.6" wide x 20.2" deep.

### WEIGHT

32 pounds. 14.5 kilograms.

### POWER CONSUMPTION

70 watts at 115V  $\pm$  10%

### ALTERNATE CONFIGURATIONS

(switch selectable - no cost)

### CURSOR

Reverse block image of character over which it is positioned; homes to upper left of screen (switch = PAGE). Underline; homes to lower left of screen (switch = BL).

### DATA ENTRY

Data entry on progressive lines, from top to bottom (switch = PAGE), entry on bottom line (switch = BL). Upward scrolling of entire display with top-of-page overflow. Automatic new line also switch-selectable. End-of-line audible tone.

### COMPUTER INTERFACES

EIA standard RS232C and 20mA current-loop.

### AUXILIARY INTERFACES

Extension RS232C port for interfacing serial asynchronous ASCII hard copy printer, magnetic tape recorder, or additional data terminals.

### COMMUNICATION RATES

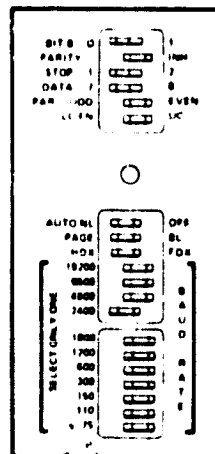
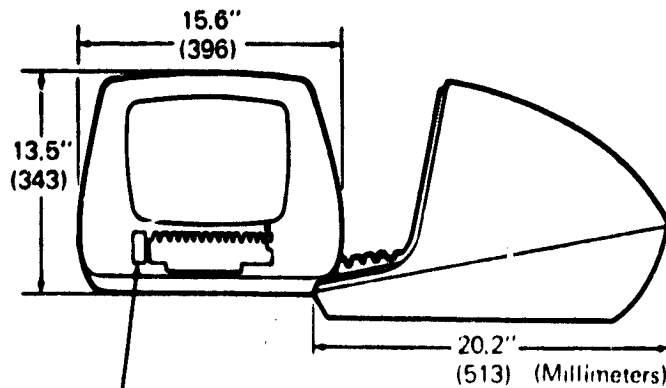
75, 110, 150, 300, 600, 1200, 1800, 2400, 4800, 9600, 19,200 baud.

### TRANSMIT/RECEIVE MODES

Full and half-duplex.

### WORD STRUCTURE

Total word length: 9, 10, or 11 bits. Data: 7 bits. Start: 1 bit. Stop: 1 or 2 bits. Parity: 1 bit (odd, even, high, low or none).



### FRONT PANEL SWITCHES (SHOWN).

Twenty switches for selecting the primary terminal operating characteristics are accessible from the ADM-3A front panel without opening the case or removing power to the unit. BIT 8=0=1. PARITY=INH. STOP-1-2. DATA-7-8. PARITY=ODD. EVEN. LOWER CASE/UPPER CASE. AUTO. NEW LINE=OFF. PAGE=BL. HALF/FULL DUPLEX.

**COMMUNICATION RATE SWITCHES:** 19200, 9600, 4800, 2400, 1800, 1200, 600, 300, 150, 110, 75.

**NOT SHOWN:** In addition to the front panel switches, the PC board inside the ADM-3A case contains 12 switches which allow selection of various terminal operating characteristics, such as: UC DISP=U/L DISP (OPTIONAL). DISABLE=KB LOCK. DISABLE=CLEAR SCREEN. -SEC CHAN. END OF TEXT. END OF TRANSMISSION RS232-CL.

### OPTIONS (at additional cost)

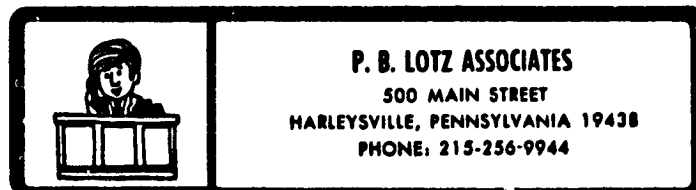
**Display Format:** 1920 characters, 24 lines of 80 characters per line.

**Character Set:** Upper and lower case, full set of 90 ASCII characters (switch selectable) upper case only; 10-key numeric pad.

**Refresh Rate:** 50Hz with input power option, switch selectable.

**Transmit/Receive Modes:** "Answer Back" capability with independently selectable transmit and receive rates.

**Power:** 50/60 Hz 230 Vac  $\pm$  10%.



**P. B. LOTZ ASSOCIATES**

500 MAIN STREET  
HARLEYSVILLE, PENNSYLVANIA 19438  
PHONE: 215-256-9944